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MECHANICAL PROPERTIES, INCLUDING FRACTURE
TOUGHNESS AND FATIGUE, CORROSION CHARACTERISTICS
AND FATIGUE-CRACK PROPAGATION RATES OF
STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

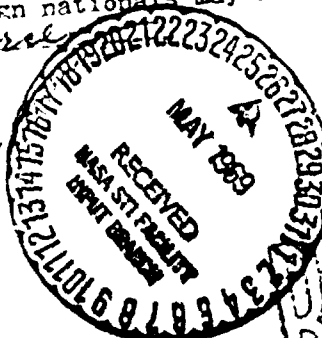
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Contract No. F33615-68-C-1385
Project No. 7381
Fifth Technical Management Report
February 15, 1969 - May 15, 1969

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ABSTRACT

The tensile, compressive, shear and bearing properties ^{were} ~~have been~~ determined for all of the 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 hand forgings being investigated. The property values and the ratios among these properties are reported. All of the tensile and compressive stress-strain tests, including modulus determinations, ~~have been~~ made. The results of the individual notch-bend fracture toughness tests are reported. All of the remaining axial-stress fatigue tests of smooth specimens were completed. ()

The current status of the stress-corrosion tests is presented. Performance of the 2024-T852 and 7075-T7352 forgings ~~was~~ has, in general, been typical of that expected for these alloy-temper combinations. Accelerated exfoliation tests of specimens from the 6x24-in. hand forgings displayed excellent resistance to exfoliation, and there was no significant difference between alloys. The fatigue crack propagation tests of the 2014-T652 specimens have been completed. The effects of notch geometry, specimen length and change of the load during testing are reported.

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Fifth Technical Management Report

MECHANICAL PROPERTIES, INCLUDING FRACTURE TOUGHNESS AND FATIGUE, CORROSION CHARACTERISTICS AND FATIGUE-CRACK-PROPAGATION RATES OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

I. Introduction.

The design mechanical properties, fracture toughness, corrosion characteristics and fatigue-crack propagation rates are four of the most important factors involved in the selection and efficient design of aircraft structures. Such data are needed for aluminum alloy hand forgings for several reasons:

(1) much of the published design data has become obsolete by a change in the basis of specifying minimum properties, from one in which the length, width and thickness were considered, to one where only the thickness is involved; (2) the development of a technique of stress relief by cold work in compression has resulted in relatively new tempers (TX52) for many of the alloys; and (3) there have been some significant problems with forged parts in recent years that were related to fracture and stress-corrosion characteristics.

Accordingly, the properties of hand forgings of several aluminum alloys currently being used in aircraft structures are being determined under this contract. The tests are intended to provide statistically reliable data for deriving design mechanical properties for MIL-HDBK-5A, including stress-strain and compressive tangent-modulus curves. In

addition, data concerning the fracture toughness, axial-stress fatigue, stress-corrosion, exfoliation and fatigue-crack propagation rates are being obtained.

This Fifth Technical Management Report summarizes the results of tests carried out during the fifth quarter of the contract, and the general status of the program at this time.

II. Material.

As previously reported in the Fourth Technical Management Report, all of the hand forging samples to be investigated have been received. They meet the applicable composition and tensile property requirements specified in Federal Specification QQ-A-367g and the Aluminum Association, "Aluminum Standards and Data", April 1968.

III. Procedure.

The specimens and test procedures being used are essentially the same as described in the First Technical Management Report, dated May 15, 1968.

IV. Progress During Quarter.

A. Mechanical Properties

A.1. Tensile, Compressive, Shear and Bearing

The remaining tensile, compressive, shear and bearing tests were completed during the quarter. The results of all the tests are summarized in Tables I through IV. The tensile properties of each sample exceed the specified minimum values

shown in Table V. Ratios among the properties of the individual samples are shown in Table VI. These ratio values have been submitted for statistical analyses.

All of the individual tensile and compressive stress-strain tests, including modulus determinations, have been made. These data are now being analyzed for preparation of typical and minimum curves which will be presented in the final report; average modulus values will also be determined.

A.2. Fracture Toughness

Notch-bend fracture toughness tests were made of all the samples scheduled for test. The test results for all but twelve of the individual specimens tested are shown in Table VII. Although some of the reported values are not strictly valid by all the criteria of the ASTM Recommended Method of Test for Plane-Strain Fracture Toughness of Metallic Materials, most of the calculated K_Q values are considered to be meaningful values of K_{Ic} . As may be noted, in most cases the stress intensity used in fatigue cracking was only slightly in excess of 50 per cent of the K_{Ic} or the fatigue crack front deviated from straightness by slightly more than 5 per cent. Retests are now being made in the twelve cases where the values obtained in the original tests were invalid because (1) the stress intensity used in fatigue cracking was definitely too high, (2) there was excessive yielding before crack propagation, or (3) because of excessive crack front deviation.

A.3. Axial-Stress Fatigue

All of the remaining axial-stress fatigue tests of smooth long-transverse specimens have been completed. The data for all of the tests are summarized in Table VIII and the results of the tests completed during this quarter (7075-T7352) are plotted in Fig. 1.

In general, the log-mean fatigue life values of the respective hand forging alloys are about the same or slightly higher than those of extrusions tested in a previous contract, AF33(615)-3580, and slightly lower than those of plate tested in previous contracts AF33(657)-11155 and AF33(615)-2012.

B. Corrosion Characteristics

B.1. Resistance to Stress-Corrosion Cracking

Stress-corrosion tests of short-transverse specimens from the 2x8, 3x12 and 5x20-in. hand forgings were completed during this quarter. Tests of longitudinal and long-transverse specimens from these forgings are continuing, and have now been in progress for 164 days.

All of the stress-corrosion test specimens from the 4x16-in. and 6x24-in. forgings were exposed to the 3.5% NaCl alternate-immersion test during the quarter.

The current status of stress-corrosion tests of longitudinal and long-transverse specimens is given in Table IX, and of the short-transverse specimens in Table X.

Thus far, no longitudinal test specimen has failed. While tests of the 4 and 6-in. thick forgings have progressed

For only short periods, tests of specimens from the 2-in. thick forgings have nearly completed the 182-day exposure without failure, thereby confirming the expected high resistance of all alloy-temper combinations in this direction.

Long-transverse failures have occurred only with 2014-T652 and 7079-T652 specimens stressed at 75% of the tensile yield strength. Representative failures were examined microscopically and the mode of failure was confirmed as stress-corrosion cracking.

The results of tests of short-transverse specimens from the 2, 3 and 5-in. thick forgings were considered in the Fourth Technical Management Report, and it was observed that the performance of the 2014-T652 and 7079-T652 materials was better than that typically seen for these alloys. The performance was within the bounds of existing stress-corrosion data for the alloys, however, and therefore wasn't questioned at that time. Subsequent test results for the 4 and 6-in. forgings revealed more typical performance (see following paragraphs), however. Since the 2-in. thick forgings would be expected to show an even greater susceptibility to stress-corrosion cracking than the 4 and 6-in. thick material, specimens are being obtained for retests to verify the test results for the 2-in. thick 2014-T652 and 7079-T652 forgings.

Tests of short-transverse specimens from the 4-in. thick forgings have progressed for a period of 48 days, and the results are in agreement with expected performance of the

Fifth Technical Management Report

MECHANICAL PROPERTIES, INCLUDING FRACTURE TOUGHNESS AND FATIGUE, CORROSION CHARACTERISTICS AND FATIGUE-CRACK-PROPAGATION RATES OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

I. Introduction.

The design mechanical properties, fracture toughness, corrosion characteristics and fatigue-crack propagation rates are four of the most important factors involved in the selection and efficient design of aircraft structures. Such data are needed for aluminum alloy hand forgings for several reasons: (1) much of the published design data has become obsolete by a change in the basis of specifying minimum properties, from one in which the length, width and thickness were considered, to one where only the thickness is involved; (2) the development of a technique of stress relief by cold work in compression has resulted in relatively new tempers (TX52) for many of the alloys; and (3) there have been some significant problems with forged parts in recent years that were related to fracture and stress-corrosion characteristics.

Accordingly, the properties of hand forgings of several aluminum alloys currently being used in aircraft structures are being determined under this contract. The tests are intended to provide statistically reliable data for deriving design mechanical properties for MIL-HDBK-5A, including stress-strain and compressive tangent-modulus curves. In

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crack growth rates were determined from the slopes of the crack propagation curves.

Figs. 6 and 7 show the data for the 24-in. long specimens (sharp notch) whose tests were started at a maximum gross stress of 8.2 ksi. Cracks were not visible at all four corners of the notch of specimen 14 until the total crack length was beyond 0.5 in.; specimens with this great an eccentricity are excluded from the discussion. The humidity appears to have affected the rate of propagation of the specimens stressed to this level; specimens 18 and 20, which were tested under the most humid conditions, had the highest rates of propagation. There does not seem to be such a correlation in Figs. 8 and 9 for specimens initially stressed to 12.5 ksi. Crack initiation was more uniform at the higher stress.

C.1. Notch Shape

The crack growth data for the specimens having the two shapes of 0.5-in. long machined notches (Figs. 20 and 21) are presented in Figs. 2 and 4 and the crack growth rates in Figs. 3 and 5. The crack growth rates for the mild-notched specimens (Fig. 20) are generally within the range of those of the sharp-notched specimens (Fig. 21). Even eliminating particularly eccentrically-cracked specimens such as mild-notch specimen No. 4 from consideration, there was more scatter in the results shown for duplicate specimens than was shown for specimens having the sharp notches. The fracture surfaces of mild-notched specimens 7 and 10, which showed a large difference in crack growth rate,

were visually different as were those of the adjacent sharp-notched specimens 8 and 11. Cross-sections of the surfaces of specimens 7 and 10 are shown in Fig. 23. Specimen 7 has a directional or fibrous type structure in the fractured region whereas the faster propagating specimen 10 shows a coarse, non-fibrous structure. These specimens were taken at locations about 3 in. apart from the same central portion of the cross-section.

The most eccentric cracking was obtained for specimens having the mild notch. However, few specimens having either notch had as uniform crack initiation as desired. As reported in the Fourth Technical Management Report, crack initiation was somewhat more uniform for 7178-T651 specimens having a thin elox notch. In general, it does not appear that the crack growth is significantly different for the specimens having mild or sharp notches.

C.2. Specimen Length

The results for specimens tested to determine the effect of length of test section are plotted in Figs. 10 through 13. At a stress of 8.2 ksi, the results for the short (6-in.) specimens are generally within the range of the results for the long (24-in.) ones. At a stress of 12.5 ksi, the rate of crack growth of 6-in. long specimen 9 was somewhat lower for cracks beyond 1/2 in. than those of any of the three 24-in. long specimens having the similar sharp notches. However, propagation was not as slow as shown in Fig. 5 for specimen 7 having a mild

notch. Thus, it appears that the short specimens will be suitable for evaluating the crack propagation behavior for short-transverse specimens.

C.3. Change in Load

Figs. 14 and 15 present the data for all specimens for which loads were changed when the crack length reached 0.5 in. Thus, in Fig. 14, there is a new zero cycle origin at a notch plus crack length of 1 in. (33.3%). The crack growth rates of specimens 16 and 19 after the reduction in load correlate well with the plots for their initial loading at 12.5 ksi. For specimen 13, however, the growth at this reduced load is substantially slower up to a ΔK of about 10.5. The crack growth of this specimen during its loading to 12.5 ksi had also been slower than that of any other specimen stressed to that level so its slow propagation at 8.2 ksi does not appear to be a result of the higher loading.

In Figs. 16 and 17, the crack propagation results for the specimen whose gross stresses were reduced from 12.5 to 8.2 ksi after the crack length reached 0.5 in. are compared with the plots of specimens tested entirely at 8.2 ksi. Although it is not shown, a "rest" period of no propagation occurs when the load is reduced. When propagation resumed, crack growth was slower for specimen 13 and faster for specimen 19 than was found for any specimens tested entirely at 8.2 ksi. However, the general slopes for the crack growth rate plots are similar for the two methods of test.

Figs. 18 and 19 show the results of the tests in which the cracks were developed to 0.5 in. at 8.2 ksi and then propagated to failure at 12.5 ksi. Generally, the propagation at the low stress does not appear to have affected the rate of propagation at the higher stress.

The data indicate that the test loads can be raised or lowered between the levels of 8.2 and 12.5 without significantly affecting subsequent propagation. The reduction in load procedure would appear to be more practical than the increase in load. However, for the method to be worthwhile, it is necessary that it be possible to extrapolate the rate of crack growth to lower or higher values of ΔK . Judging from the data for specimens tested entirely at one load level, extrapolation of the data would not be reliable. This may be a result of the eccentric cracking. If the revised test method described below does produce uniform cracking, some specimens of the other alloys may be tested using a reduction of load method.

Tests of specimens of alloys 2024-T652 and 7079-T652 have been started. In order to obtain more uniform cracking than was found for the 2014-T652 specimens, cracks are being initiated at the ends of a 0.20-in. long elox notch (Fig. 22) using a load cycle of 0 to 12.5 ksi gross stress. When cracks are visible at all four corners of the notch the load is adjusted to the desired level and the crack propagated to 0.5 in. The test is considered to start at this point. For the first two specimens, this has produced uniform crack lengths.

V. Summary.

All of the tensile, compressive, shear and bearing tests have now been completed and the test results are shown in Tables I through IV. The tensile properties of the samples meet the applicable minimum-property requirements shown in Table V. The ratios among the properties are summarized in Table VI; they have been submitted for statistical analyses.

All of the tensile and compressive stress-strain tests, including modulus determinations, have been made. The test data are being computed and analyzed.

Notch-bend fracture-toughness tests were made of all the samples scheduled for test. The results of the individual tests are presented in Table VII for all but four groups of specimens whose K_{IC} values were considered invalid for reasons related to unsatisfactory precracking of the specimens; re-tests are now in progress.

The remaining axial-stress fatigue tests were completed. The results of the tests are shown in Table VIII and plotted in Fig. 1.

The current status of stress-corrosion tests is given in Tables IX and X. Some disparity was noted in the performance of 2014-T652 and 7079-T652 forgings, with the 4 and 6-in. thick forgings showing a greater (but still typical) susceptibility to stress-corrosion cracking than the 2-in. forgings. Specimens are being obtained for retests to verify the performance of the 2-in. forgings. The performance of the 2024-T852 and 7075-T7352

forgings has generally been typical of that expected for these alloy-temper combinations.

The fatigue-crack propagation tests of the 2014-T652 specimens have been completed. The tests (long-transverse specimens) showed that (1) the use of a sharper notch than was used in previous investigations did not appear to alter the crack propagation behavior significantly, (2) the 6-in. long specimens (which will be used for short-transverse tests of 2024-T852 and 7075-T7352) gave essentially the same rates of propagation as the 24-in. long specimens, and (3) when the load was changed, the rate of propagation was not affected by the previous loading.

Crack propagation tests of 2024-T852 and 7079-T652 specimens have been initiated. Use of a 0.20-in. long elox notch instead of a 0.50-in. machined notch and crack initiation at a higher stress have produced more uniform cracking in the first several specimens. The 7075-T7352 specimens are also being elox notched.

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VI. Tables and Figures.

TABLE I

MECHANICAL PROPERTIES OF STRESS-RELIEVED 2014-T652 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

SAMPLE CROSS- SECTIONAL NUMBER DIREC- TION\$	ULT. STRESS, PSI	TENSILE		COMP. YIELD STRESS,* PSI	SHEAR ULT. STRESS, PSI	BEARING: EDGEWISE	
		YIELD STRESS,* PSI	ELONG. IN 2 IN. % OR 40, %			ULT. STRESS, PSI e/D=1.5	YIELD STRESS,* PSI e/D=1.5 e/D=2.0
2X 8 341007	L	71 600	11.5	69 200	44 200	101 000	87 600 101 600
	LT	71 700	6.0	70 300	43 600	101 000	89 300 100 200
	ST	66 400	9.4	68 700	---	---	---
3X12 341008	L	71 800	10.5	68 400	42 200	102 300	89 600 107 300
	LT	71 000	7.5	69 800	41 800	97 100	88 600 106 200
	ST	69 700	5.0	69 700	41 300	---	---
4X 8 341009	L	70 300	12.5	66 400	40 400	89 300	85 500 103 000
	LT	69 900	7.5	65 100	40 600	90 700	87 200 102 100
	ST	66 900	2.5	69 300	39 900	---	---
4X16 341010	L	69 100	11.5	61 400	38 700	106 800	86 200 97 400
	LT	66 600	6.0	61 500	38 800	101 900	86 500 93 900
	ST	65 800	6.0	61 900	38 900	---	---
5X 5 341011	L	68 600	12.0	65 300	41 800	88 200	85 900 101 300
	LT	67 500	4.0	62 500	40 700	87 200	85 900 100 400
	ST	65 200	2.0	66 500	41 200	---	---
5X10 341012	L	68 800	11.5	63 000	40 600	93 400	82 700 94 300
	LT	67 300	5.5	61 700	40 300	88 700	83 600 99 000
	ST	64 600	3.0	65 300	38 700	---	---
5X20 341013	L	68 500	11.5	61 200	38 800	90 100	79 000 94 300
	LT	64 700	5.0	63 500	38 400	86 600	79 000 94 700
	ST	63 900	3.7	62 800	37 300	---	---
6X 6 341014	L	67 700	12.0	64 000	42 400	97 400	86 700 97 500
	LT	64 900	3.5	60 400	40 700	89 300	83 900 101 100
	ST	64 200	2.8	65 700	40 500	---	---
6X12 341015	L	66 200	11.0	60 300	40 200	91 100	81 600 96 100
	LT	64 200	3.5	61 900	38 800	87 700	80 600 98 800
	ST	63 900	3.5	61 900	38 700	---	---
6X24 341016	L	63 000	9.5	57 900	42 500	89 500	81 200 99 700
	LT	66 600	6.0	62 400	38 800	86 300	80 000 98 900
	ST	62 600	6.0	59 300	39 000	---	---

* OFFSET EQUALS 0.2 PER CENT

† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER

‡ SPECIMENS AND FIXTURES CLEANED ULTRASONICALLY

\$ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

Table I

TABLE II

MECHANICAL PROPERTIES OF STRESS-RELIEVED 2024-T852 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

SAMPLE CROSS- SECTIONAL NUMBER DIREC- TION\$	SIZE, IN.	TENSILE				RED. OF AREA. %	COMP. YIELD STRESS,* PSI	SHEAR STRESS, PSI	BEARING [‡] EDGWISE		YIELD STRESS,† PSI	
		ULT. STRESS, PSI	YIELD STRESS,* PSI	ELONG. IN 2 IN. OR 4D, %	ULT. STRESS, PSI				e/D=1.5	e/D=2.0		
2X 8	341017	L	70 800	64 600	7.0	28	70 200	42 700	97 700	133 100	95 500	116 300
		LT	72 300	63 800	9.0	17	72 700	41 800	94 500	125 900	89 500	114 200
		ST	67 400	64 000	1.6	3	74 600	---	---	---	---	---
3X12	341018	L	72 200	66 700	5.5	18	70 000	42 400	94 900	123 400	93 700	109 300
		LT	73 700	69 000	3.0	2	75 800	42 000	94 500	126 100	93 500	113 300
		ST	68 100	64 400	1.0	2	72 200	40 200	---	---	---	---
4X 8	341019	L	68 900	61 100	9.0	26	62 200	40 500	91 900	117 900	82 500	100 500
		LT	70 400	63 200	5.0	8	63 500	39 500	88 800	119 400	82 800	101 000
		ST	65 700	57 200	3.2	4	65 500	38 600	---	---	---	---
4X16	341020	L	71 400	65 400	6.5	23	66 600	41 100	92 100	124 000	87 400	104 800
		LT	71 000	65 200	5.0	8	71 500	40 200	91 500	127 100	90 500	106 200
		ST	70 100	60 600	2.4	6	70 200	39 900	---	---	---	---
5X 5	341021	L	69 000	62 000	8.5	29	63 400	40 800	93 500	125 200	89 900	105 100
		LT	68 400	62 100	3.0	1	63 100	40 700	89 100	121 600	84 400	101 100
		ST	66 500	56 000	2.8	4	64 700	39 600	---	---	---	---
5X10	341022	L	68 400	61 000	8.5	25	63 000	40 300	89 100	114 300	87 700	96 800
		LT	69 100	61 500	6.0	8	64 800	39 700	89 500	120 200	85 100	99 600
		ST	66 100	59 800	1.5	4	68 400	38 800	---	---	---	---
5X20	341023	L	65 200	55 100	9.0	16	57 800	38 800	83 600	112 600	79 300	94 400
		LT	62 800	56 700	3.0	4	60 700	38 000	84 900	114 600	82 500	98 000
		ST	63 200	54 500	3.0	3	59 400	37 000	---	---	---	---
6X 6	341024	L	69 100	61 600	9.0	28	63 700	41 500	95 300	123 900	89 800	102 200
		LT	68 800	60 600	6.5	10	61 500	40 600	92 000	123 200	86 900	102 700
		ST	69 400	58 500	2.3	3	67 600	39 800	---	---	---	---
6X12	341025	L	67 000	58 700	8.0	22	59 700	39 600	84 700	117 100	82 400	100 500
		LT	67 400	60 200	3.2	4	63 500	38 400	85 700	113 400	81 400	95 700
		ST	65 300	55 100	2.9	3	63 000	37 400	---	---	---	---
6X24	341026	L	64 300	56 100	7.5	20	56 000	37 100	80 900	111 700	80 500	95 000
		LT	65 400	57 800	5.0	8	57 500	36 100	84 300	98 600	79 900	90 600
		ST	58 000	53 900	1.0	1	58 000	34 900	---	---	---	---

* OFFSET EQUALS 0.2 PER CENT

† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER

‡ SPECIMENS AND FIXTURES CLEANED ULTRASONICALLY

\$ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

TABLE II

MECHANICAL PROPERTIES OF STRESS-RELIEVED 7075-T7352 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

SAMPLE CROSS- SECTIONAL NUMBER DIREC- TION\$	SIZE, IN.	TENSILE			RED. OF AREA, %	COMP. YIELD STRESS,* PSI	SHEAR ULT. STRESS, PSI	BEARING [‡] EDGEWISE	
		ULT. STRESS, PSI	YIELD STRESS, PSI	ELONG. IN 2 IN. OR 4D, %				ULT. STRESS, PSI e/D=1.5	YIELD STRESS, [†] PSI e/D=1.5 e/D=2.0
2X 8	341027	73 700	65 300	13.5	43	69 300	46 800	111 900	93 700 111 200
		74 900	65 300	13.5	29	68 800	44 500	110 600	92 700 106 500
		73 100	61 800	6.3	9	69 300	---	---	---
3X12	341028	76 400	66 200	11.5	27	66 900	42 400	103 100	89 000 103 800
		71 400	59 300	8.0	11	65 300	42 600	98 300	89 800 110 300
		73 000	60 800	4.2	5	69 300	42 900	---	---
4X 8	341029	68 400	57 300	15.0	42	60 200	39 800	95 100	83 500 98 600
		65 100	53 000	10.0	17	57 600	38 400	98 500	81 400 99 000
		64 500	50 600	6.4	10	57 500	38 200	---	---
4X16	341030	70 000	59 500	13.0	34	59 600	40 600	95 300	82 900 95 800
		67 600	55 200	12.0	25	59 700	40 700	94 200	82 600 99 200
		64 800	52 500	6.4	7	58 600	39 100	---	---
5X 5	341031	68 400	56 700	14.0	39	59 400	41 500	104 400	84 300 99 000
		67 200	55 100	10.5	20	56 600	40 600	98 000	83 500 100 700
		63 800	51 700	4.0	6	59 500	41 500	---	---
5X10	341032	65 200	52 700	14.0	37	53 400	39 600	95 900	82 300 91 900
		64 000	51 400	9.0	17	53 800	38 500	97 700	80 100 97 000
		64 200	49 500	7.0	9	58 000	39 400	---	---
5X20	341033	64 800	52 500	14.5	35	52 200	38 800	94 100	76 800 89 100
		64 000	50 700	11.0	25	54 400	38 300	91 500	77 100 92 600
		63 700	49 300	6.5	10	54 900	38 000	---	---
6X 6	341034	62 400	51 100	15.0	44	54 000	41 300	99 300	82 100 94 400
		63 800	52 100	10.0	23	53 000	40 100	97 400	81 600 96 100
		63 400	49 700	8.0	14	55 300	39 000	---	---
6X12	341035	63 300	52 600	12.5	34	50 300	39 800	98 700	80 000 94 600
		63 400	50 900	9.0	14	51 200	38 800	95 000	79 400 95 000
		60 800	49 800	6.5	9	54 400	37 400	---	---
6X24	341036	65 800	55 400	12.5	34	51 400	38 700	93 700	76 000 84 900
		62 100	50 300	9.5	16	52 300	39 000	85 600	71 600 82 700
		62 600	49 200	6.5	10	53 800	37 200	---	---

* OFFSET EQUALS 0.2 PER CENT

† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER

‡ SPECIMENS AND FEATURES CLEANED ULTRASONICALLY

\$ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

Table III

TABLE IV

MECHANICAL PROPERTIES OF STRESS-RELIEVED 7079-T652 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

CROSS-SECTIONAL SIZE, IN.	SAMPLE NUMBER DIRECTION\$	TENSILE				RED. OF AREA, %	COMP.	SHEAR	BENDING			
		ULT. STRESS, PSI	YIELD STRESS, PSI	ELONG. IN 2 IN. OR 4D, %	YIELD STRESS, PSI				EDR, %			
									ULT. STRESS, PSI	YIELD STRESS, PSI		
2X 8	341037	L	78 600	71 000	14.0	34	73 300	48 700	115 100	154 700	99 100	114 400
		LT	76 100	64 900	12.0	20	73 200	46 500	114 500	149 100	98 000	113 400
		ST	76 000	63 700	7.8	10	74 200	---	---	---	---	---
3X12	341038	L	77 500	68 700	13.0	26	71 300	46 400	113 200	148 800	94 800	112 900
		LT	76 100	65 700	12.0	26	70 700	46 100	116 600	145 100	97 900	114 600
		ST	73 700	61 400	8.0	11	71 800	45 400	---	---	---	---
4X 8	341039	L	78 800	69 600	11.0	21	72 800	48 900	111 600	148 300	99 400	115 200
		LT	77 500	66 500	11.5	24	72 900	48 200	117 100	148 700	102 300	117 200
		ST	74 300	62 800	5.0	6	73 200	47 300	---	---	---	---
4X16	341040	L	77 900	68 000	12.0	22	70 100	46 600	113 000	145 900	95 200	110 300
		LT	74 600	63 000	9.5	18	66 800	45 700	107 500	144 400	94 000	105 700
		ST	74 000	62 900	7.9	17	70 600	44 900	---	---	---	---
5X 5	341041	L	75 600	67 600	13.0	27	69 700	47 900	112 600	149 900	94 400	108 900
		LT	72 900	63 000	8.5	12	67 000	45 900	105 200	143 600	92 100	107 200
		ST	71 300	59 500	7.0	10	66 400	46 300	---	---	---	---
5X10	341042	L	76 100	68 000	13.0	27	68 800	45 700	108 200	140 900	92 800	107 000
		LT	74 100	62 600	10.5	19	69 300	45 900	108 300	141 300	94 300	109 100
		ST	73 000	61 300	5.5	5	72 200	44 400	---	---	---	---
5X20	341043	L	76 900	65 600	13.0	24	67 000	46 200	104 600	135 900	91 800	106 400
		LT	73 300	61 400	11.0	19	65 700	46 400	103 300	136 900	89 800	105 400
		ST	71 300	58 300	6.0	7	68 300	44 000	---	---	---	---
6X 6	341044	L	73 600	63 800	15.0	37	68 900	48 400	112 200	148 100	95 600	105 400
		LT	72 600	61 400	9.0	16	69 700	47 900	111 000	146 000	96 700	109 400
		ST	71 700	61 800	8.5	14	67 100	47 300	---	---	---	---
6X12	341045	L	75 200	65 700	11.0	25	67 500	46 300	109 000	139 300	93 800	107 500
		LT	72 800	62 100	7.5	12	66 200	45 500	104 000	140 700	92 300	107 600
		ST	72 400	58 800	6.0	7	69 300	44 700	---	---	---	---
6X24	341046	L	73 900	63 900	12.0	22	63 300	43 800	94 300	128 300	85 200	98 100
		LT	69 100	57 500	10.0	22	62 900	42 000	87 700	123 300	83 300	97 200
		ST	69 300	58 100	4.5	6	67 300	42 000	---	---	---	---

* OFFSET EQUALS 0.2 PER CENT

- OFFSET EQUALS 2 PER CENT OF PIN DIAMETER

+ SPECIMENS AND FEATURES CLEANED ULTRASONICALLY

§ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

Table IV

TABLE 7

SPECIFIED MINIMUM VALUES FOR ALUMINUM ALLOY END PRODUCTS
(7075-T6-3-1955)

Alloy and Temper	Thickness, in.	Longitudinal Strength, •		Torsional Strength, •		Tension Strength, •		Compression Strength, •		Remarks, Specification
		psi	ksi	psi	ksi	psi	ksi	psi	ksi	
2024-T52	Up thru 2.000	55 000	55 000	55 000	55 000	55 000	55 000	55 000	55 000	2024-T52
	2.001-3.000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	
	3.001-4.000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	
	4.001-6.000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	
2024-T52	5.001-6.000	61 000	61 000	61 000	61 000	61 000	61 000	61 000	61 000	None
	All	---	---	---	---	---	---	---	---	
	Up thru 2.000	55 000	55 000	55 000	55 000	55 000	55 000	55 000	55 000	
	2.001-3.000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	
7075-T652	3.001-4.000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	None**
	4.001-5.000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	62 000	
	5.001-6.000	61 000	61 000	61 000	61 000	61 000	61 000	61 000	61 000	
	Up thru 2.000	72 000	72 000	72 000	72 000	72 000	72 000	72 000	72 000	
7075-T652	2.001-3.000	72 000	72 000	72 000	72 000	72 000	72 000	72 000	72 000	2024-T52
	3.001-4.000	71 000	71 000	71 000	71 000	71 000	71 000	71 000	71 000	
	4.001-5.000	70 000	70 000	70 000	70 000	70 000	70 000	70 000	70 000	
	5.001-6.000	69 000	69 000	69 000	69 000	69 000	69 000	69 000	69 000	

• Offset equals 0.2 per cent.

** The Aluminum Association, "Aluminum Standards and Data", April 1966.

These values have been submitted for inclusion in a proposed revision C of MIL-A-22771 and presumably will also be included in the next revision of QQ-A-367.

Table V

TABLE VI

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

ALLOY AND TEMPER	CROSS SECT. SIZE, NUMBER IN.	SAMPLE		TENSILE		COMPRESSIVE		SHEAR		BEARING	
		CYS(L) Y(SL)	CYS(SI) Y(SI)	SS(L) Y(SL)	SS(SI) Y(SI)	BS(L) Y(SL)	BS(SI) Y(SI)	BS(L) Y(SL)	BS(SI) Y(SI)	BS(L) Y(SL)	BS(SI) Y(SI)
2014-T652	2X 8 341007	1.04	1.08	1.12	0.62	0.61	---	1.41	1.71	1.35	1.56
	3X12 341008	1.03	1.07	1.12	0.59	0.59	0.58	1.44	1.87	1.38	1.65
	4X 8 341009	1.03	1.03	1.17	0.58	0.58	0.57	1.28	1.77	1.36	1.63
	4X16 341010	0.98	1.04	1.08	0.58	0.58	0.58	1.60	1.86	1.46	1.65
	5X 5 341011	1.03	1.02	1.13	0.62	0.60	0.61	1.31	1.74	1.40	1.65
	5X10 341012	1.02	1.02	1.14	0.60	0.60	0.57	1.39	1.74	1.37	1.57
	5X20 341013	1.01	1.11	1.12	0.60	0.59	0.58	1.39	1.75	1.38	1.65
	6X 6 341014	1.03	1.02	1.18	0.65	0.63	0.62	1.50	1.76	1.46	1.64
	6X12 341015	1.01	1.06	1.12	0.63	0.60	0.60	1.42	1.87	1.40	1.64
	6X24 341016	1.04	1.08	1.10	0.64	0.58	0.59	1.34	1.77	1.41	1.73
2024-T652	2X 8 341017	1.09	1.14	1.17	0.59	0.58	---	1.35	1.84	1.50	1.82
	3X12 341018	1.05	1.10	1.12	0.58	0.57	0.55	1.29	1.67	1.36	1.58
	4X 8 341019	1.02	1.01	1.15	0.58	0.56	0.55	1.30	1.67	1.31	1.59
	4X16 341020	1.02	1.10	1.16	0.58	0.57	0.56	1.30	1.74	1.34	1.61
	5X 5 341021	1.02	1.02	1.15	0.60	0.59	0.58	1.37	1.83	1.45	1.69
	5X10 341022	1.03	1.05	1.14	0.58	0.57	0.56	1.29	1.65	1.43	1.57
	5X20 341023	1.05	1.07	1.09	0.62	0.61	0.59	1.33	1.79	1.40	1.67
	6X 6 341024	1.03	1.01	1.16	0.60	0.59	0.58	1.39	1.80	1.48	1.69
	6X12 341025	1.02	1.06	1.14	0.59	0.57	0.56	1.26	1.74	1.37	1.67
	6X24 341026	1.00	0.99	1.08	0.57	0.55	0.53	1.24	1.71	1.39	1.64
7075-T7352	2X 8 341027	1.06	1.05	1.12	0.62	0.59	---	1.49	1.96	1.44	1.70
	3X12 341028	1.01	1.10	1.14	0.59	0.60	0.60	1.44	1.91	1.50	1.75
	4X 8 341029	1.05	1.09	1.14	0.61	0.59	0.59	1.46	2.00	1.58	1.86
	4X16 341030	1.00	1.08	1.12	0.60	0.60	0.58	1.41	1.86	1.50	1.73
	5X 5 341031	1.05	1.03	1.15	0.62	0.60	0.62	1.55	1.96	1.53	1.79
	5X10 341032	1.01	1.05	1.17	0.62	0.60	0.62	1.50	1.95	1.60	1.79
	5X20 341033	1.00	1.07	1.11	0.61	0.60	0.59	1.47	1.88	1.51	1.76
	6X 6 341034	1.06	1.02	1.11	0.65	0.63	0.61	1.53	2.06	1.58	1.81
	6X12 341035	0.96	1.01	1.09	0.63	0.61	0.59	1.56	1.95	1.57	1.86
	6X24 341036	0.93	1.04	1.09	0.62	0.63	0.60	1.51	1.83	1.51	1.69
7079-T652	2X 8 341037	1.03	1.13	1.17	0.64	0.61	---	1.51	2.03	1.53	1.76
	3X12 341038	1.04	1.08	1.17	0.61	0.61	0.60	1.49	1.95	1.44	1.72
	4X 8 341039	1.05	1.10	1.16	0.63	0.62	0.61	1.44	1.91	1.50	1.73
	4X16 341040	1.03	1.06	1.12	0.62	0.61	0.60	1.52	1.96	1.51	1.75
	5X 5 341041	1.03	1.06	1.15	0.66	0.63	0.64	1.54	2.06	1.50	1.73
	5X10 341042	1.01	1.11	1.18	0.62	0.62	0.60	1.46	1.90	1.48	1.71
	5X20 341043	1.02	1.07	1.17	0.63	0.63	0.60	1.43	1.85	1.50	1.73
	6X 6 341044	1.08	1.14	1.09	0.67	0.66	0.65	1.55	2.04	1.56	1.72
	6X12 341045	1.03	1.07	1.18	0.64	0.63	0.61	1.50	1.91	1.51	1.73
	6X24 341046	0.99	1.09	1.16	0.63	0.61	0.61	1.36	1.86	1.48	1.71

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TABLE VII

RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1385)

Alloy and Temper	Sample Gross- Sect. Size, in.	Direction and Number	Specimen Type See Fig. 2 First TMR	Thick- ness (B), in.	Max. Load (P), lb	Fatigue Pre-Cracking† Max. Stress Intensity, K _{fc} psi/in.	Crack Length, (a), in.	At 5 Per Cent Secant Offset Load (P ₀), lb	K _Q , psi/in. ^{1/2}	Minimum Thickness, K _Q 2.5($\frac{P_0}{K_Q}$) ² , in.	Meaningful K _{IC}	Fracture Appearance # Oblique
2014-T652	2x8 341007	LW1	3	1.501	251	5 400	0.688	2 450	24 900	0.352	Yes	35
		LW2	3	1.500	251	6 200	0.752	2 320	26 900	0.410	Yes	35
		LW3	3	1.500	251	5 900	0.728	2 200	24 300	0.333	Yes	30
	3x12 341008	WLL	3	Specimen failed during fatigue cracking.	251	2 800	0.727	1 760	19 300	0.221	Yes	0
		WLL	3	1.501	251	6 100	0.748	1 680	19 200	0.219	Yes	5
		WLL	3	1.501	251	6 100	0.748	1 680	19 200	0.219	Yes	5
4x16 341010	LW1	3	3.003	1.5020	1 539	13 400	1.277	7 960	35 400	0.801	Yes††	1
		3	3.002	1.5020	1 539	11 600	1.442	8 550	32 800	0.690	Yes	35
		3	3.002	1.5020	1 539	12 100	1.485	8 520	34 200	0.750	Yes	1
	WLL	3	3.001	1.5020	1 539	12 300	1.497	5 650	23 000	0.378	Yes††	0
		3	3.002	1.5020	1 539	13 200	1.522	5 210	22 700	0.359	Yes††	0
		3	3.002	1.5020	1 539	14 400	1.642	4 950	23 700	0.399	Yes††	0
5x20 341013	TL1	1	0.500	0.2500	448	83 600	0.282	254	19 000	0.275	Yes††	5
		3	0.501	0.2506	448	72 400	0.268	182	19 000	0.277	Yes††	2
		3	0.500	0.2504	448	74 300	0.295	292	19 400	0.288	Yes††	0
	LW1	5	3.001	1.5000	1 539	123 000	1.498	7 400	30 200	0.620	Yes	20
		3	3.001	1.5000	1 539	118 000	1.460	7 180	28 200	0.538	Yes	20
		3	3.004	1.5000	1 539	127 000	1.530	6 930	29 200	0.578	Yes	18
6x24 341016	WLL	5	3.002	1.5000	1 539	13 700	1.597	4 550	20 700	0.326	Yes††	5
		3	3.004	1.5000	1 539	13 900	1.612	4 350	20 100	0.307	Yes††	0
		3	3.002	1.5000	1 539	14 600	1.662	3 650	17 900	0.243	Yes††	0
	TL1	2	1.000	0.4999	200	8 600	0.467	930	11 800	0.253	Yes	0
		3	1.000	0.5005	200	8 700	0.470	1 015	19 600	0.267	Yes	0
		3	1.000	0.4985	200	9 900	0.510	760	16 800	0.223	Yes††	0
6x24 341016	LW1	6	4.001	2.0050	2 308	13 700	2.195	13 900	43 400	1.506	Not	55
		3	4.003	2.0050	2 308	13 000	2.135	16 200	47 900	1.639	Not	25
		3	4.003	2.0040	2 308	10 100	1.815	24 250	55 700	2.483	Not	25
	WLL	6	4.007	2.0040	2 308	13 900	2.215	7 200	22 800	0.389	Yes††	2
		3	4.001	2.0050	2 308	12 600	2.092	6 900	25 400	0.460	Yes††	0
		3	4.003	2.0030	2 308	11 500	1.967	11 350	29 800	0.665	Yes	2
6x24 341016	TL1	2	1.002	0.5001	200	10 700	0.535	1 050	24 900	0.532	Yes††	5
		3	1.001	0.5000	200	8 000	0.443	1 295	23 100	0.458	Yes††	10
		3	1.001	0.5000	200	8 700	0.468	1 290	24 800	0.527	Yes††	10

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TABLE VII (Continued)
RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HARD FORDINGS
(F73615-68-C-1385)

Alloy and Temper	Sample Cross- Sect. Size, in.	Direction and Number	Specimen		Fatigue Pre-Cracking†				At 5 Per Cent Secant Offset			Meaningful K _{IC}	Fracture Appearance at 100X	
			Type See Fig. 2 First PWR	Width(W), in.	Thick- ness(B), in.	Max. Load(P), lb	Max. Stress Intensity, K _t , psi/in.	Cycles	Crack Length‡ (a), in.	Load‡ (P _Q), lb	K _Q , psi/in.			Minimum K _Q 2 (P _Q) ² , in.
2024-T652	2x8	DL1 2 3	3	1.501	0.7516	251	5 600	123 000	0.707	2 140	22 600	0.305	Yes	15
				1.501	0.7506	251	6 400	102 000	0.710	2 150	25 900	0.403	Yes††	15
				1.501	0.7516	251	5 200	134 000	0.667	2 500	24 300	0.355	Yes††	15
		VL1 2 3	3	1.500	0.7519	251	5 200	151 000	0.667	2 470	24 100	0.356	Yes††	2
				1.501	0.7537	251	5 500	642 000	0.697	2 280	23 319	0.319	Yes††	2
3x12	3x12	DL1 2 3	4	1.501	0.7491	251	6 500	82 000	0.763	1 660	19 800	0.240	Yes	5
				1.997	0.9997	605	8 300	115 000	0.935	3 600	24 600	0.340	Yes	15
				2.002	0.9990	605	8 300	174 000	0.940	3 310	22 600	0.268	Yes	20
		VL1 2 3	4	2.000	0.9995	605	8 400	171 000	0.950	3 150	21 900	0.270	Yes	15
				2.001	1.0000	605	7 900	175 000	0.905	2 990	19 400	0.198	Yes	0
4x16	4x16	DL1 2 3	5	1.999	0.9994	605	9 300	80 000	1.010	2 175	16 700	0.146	Yes††	0
				2.000	1.0010	605	9 400	17 000	1.020	2 175	16 900	0.150	Yes††	0
				3.002	1.5000	1 307	10 300	123 000	1.482	6 240	25 000	0.365	Yes††	10
		VL1 2 3	5	3.001	1.5020	1 307	12 300	115 000	1.645	5 840	28 100	0.459	Yes††	20
				3.002	1.5000	1 307	9 900	174 000	1.445	7 500	28 900	0.488	Yes	30
5x20	5x20	TL1 2 3	1	0.500	0.2495	45	7 500	58 000	0.267	223	15 000	0.154	Yes	0
				0.501	0.2498	45	7 700	62 000	0.272	228	15 800	0.169	Yes	0
				0.500	0.2499	45	7 100	74 000	0.258	254	16 100	0.176	Yes	5
		DL1 2 3	5	3.003	1.5030	1 307	9 400	130 000	1.395	7 380	27 000	0.599	Yes	20
				3.003	1.5020	1 307	9 400	152 000	1.400	7 110	26 100	0.522	Yes	20
6x24	6x24	VL1 2 3	5	3.001	1.5040	1 307	10 900	168 000	1.542	6 620	28 300	0.658	Yes††	15
				3.001	1.5000	1 307	9 700	146 000	1.422	4 600	17 300	0.234	Yes††	0
				3.002	1.5020	1 307	10 500	172 000	1.507	4 340	17 800	0.248	Yes††	0
		TL1 2 3	2	1.5010	0.7499	1 307	11 100	176 000	1.553	4 060	17 600	0.240	Yes††	0
				0.5000	0.2499	200	9 900	145 000	0.513	685	15 100	0.193	No***	0
6x24	6x24	DL1 2 3	6	0.4999	0.2499	200	9 200	110 000	0.490	780	16 000	0.215	Yes††	0
				0.4999	0.4999	200	8 800	139 000	0.473	810	15 800	0.210	Yes††	0
				1.001	0.4999	200	8 800	139 000	0.473	810	15 800	0.210	Yes††	0
		VL1 2 3	6	1.9990	1.9990	2 308	11 000	144 000	1.925	11 250	28 200	0.631	Yes	15
				2.0010	2.0010	2 308	12 600	219 000	2.068	10 800	30 600	0.756	Yes	15
6x24	6x24	DL1 2 3	6	2.0020	2.0020	2 308	13 800	252 000	2.202	9 800	30 800	0.752	Yes††	10
				0.5002	0.5002	187	9 300	276 000	0.512	740	16 400	0.230	Yes††	0
				0.5002	0.5002	187	9 100	270 000	0.505	685	14 800	0.168	Yes††	0
		VL1 2 3	2	0.5003	0.5003	187	9 100	234 000	0.507	800	17 300	0.257	Yes††	0
				0.5003	0.5003	187	9 100	234 000	0.507	800	17 300	0.257	Yes††	0

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Table VII (Cont'd)

TABLE VII (Continued)
 RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS
 OF STRESS-RELIEVED ALUMINUM ALLOY HARD POWERS

(F73615-68-C-1985)

Sample Alloy and Temper	Cross- Sect. Size, in.	Number	Specimen			Fatigue Pre-Cracking ^a			At 5 Per Cent Secant Offset			Meaningful K _{IC}	Fracture Appearance at Failure		
			Direction and Number	Type See Fig. 2 First Notch	Width (W), in.	Thick- ness (B), in.	Max. Load (P), lb	Max. Stress Intensity, K _{IC} , psi/in.	Cycles	Crack Length (a), in.	Load (P), lb			K _{IC} , psi/in.	Minimum Thickness, K _{IC} 2.5($\frac{a}{B}$), in.
7075-T7352	2x8	341027	TL1 2 3	3	1.498 1.501 1.501	0.7510 0.7536 0.7515	251	5 800	98 000	0.722	2 940	32 200	0.507	Yes	25
							251	6 100	64 000	0.746	2 650	30 300	0.537	Yes	16
							251	6 100	149 000	0.746	2 750	31 600	0.566	Yes	25
	3x12	341028	TL1 2 3	3	1.501 1.499 1.501	0.7505 0.7511 0.7528	251	5 900	139 000	0.728	2 150	23 700	0.530	Yeast	10
							251	6 700	183 000	0.785	1 920	24 000	0.538	Not	9
							251	6 100	186 000	0.750	2 100	24 200	0.543	Yeast	5
4x16	341030	TL1 2 3	4	1.998 2.001 1.998	0.9990 0.9998 0.9985	504	7 100	116 000	0.955	4 330	30 500	0.530	Yes	40	
						504	7 400	248 000	0.993	4 120	30 600	0.535	Yeast	40	
						504	7 400	248 000	0.985	4 500	33 100	0.626	Yes	18	
	341031	341032	TL1 2 3	5	1.997 2.003 1.997	0.9980 0.9996 1.0000	605	10 000	62 000	1.055	3 280	27 200	0.524	Not	0
							605	9 900	91 000	0.992	3 170	23 500	0.591	Yes	0
							605	8 700	57 000	0.968	3 175	22 800	0.569	Yes	0
5x20	341033	TL1 2 3	5	3.003 3.003 3.003	1.5000 1.5000 1.4980	1 282	12 500	229 000	1.677	6 940	34 600	0.843	Yes	10	
						1 282	11 300	197 000	1.595	6 960	31 200	0.687	Yes	7	
						1 282	11 600	206 000	1.610	7 010	32 400	0.739	Yes	5	
	341035	341036	TL1 2 3	1	0.500 0.501 0.500	0.2491 0.2498 0.2495	45	7 900	81 000	0.273	5 490	28 200	0.651	Yeast	4
							45	8 300	64 000	0.282	5 670	24 300	0.508	Yeast	0
							45	7 500	93 000	0.267	5 770	26 300	0.569	Yea	0
6x24	341037	TL1 2 3	5	3.003 3.001 3.004	1.5020 1.5030 1.4990	1 307	11 300	119 000	1.577	7 920	35 100	1.159	Yeast	10	
						1 307	10 500	123 000	1.507	8 080	33 200	1.002	Yes	10	
						1 307	11 700	106 000	1.607	7 960	36 500	1.211	Yes	10	
	341039	341040	TL1 2 3	5	3.002 3.002 3.002	1.5000 1.5000 1.5010	1 307	10 900	102 000	1.577	6 720	28 600	0.794	Yeast	0
							1 307	11 100	103 000	1.553	6 540	28 300	0.780	Yeast	5
							1 307	10 500	66 000	1.505	6 600	27 100	0.715	Yeast	5
6x24	341041	TL1 2 3	2	1.001 1.001 1.001	0.5000 0.5000 0.5000	200	8 300	158 000	0.493	915	19 000	0.372	Yes	0	
						200	8 000	137 000	0.478	960	18 600	0.346	Yes	0	
						200	8 400	99 000	0.458	960	18 300	0.344	Yes	0	
	341043	341044	TL1 2 3	6	3.998 3.997 3.997	2.0020 2.0020 2.0020	2 500	14 200	141 000	2.138	13 300	39 700	1.668	Yeast	5
							2 500	14 500	87 000	2.160	12 900	39 300	1.631	Yeast	10
							2 500	15 100	143 000	2.203	13 100	41 400	1.814	Not	20
341045	341046	TL1 2 3	6	4.002 4.001	2.0020 2.0030	2 500	13 900	139 000	2.118	9 500	27 800	0.859	Yeast	0	
						2 500	14 600	275 000	2.173	9 000	27 600	0.848	Yeast	0	

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Table VII (Concl'd)

TABLE VII (Concluded)
RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORMINGS
(F33615-68-C-1385)

Alloy Temp	Sample Size, In.	Direction and Number	Specimen Type	Width (W), In.	Thick- ness (B), In.	Max. Load (P), lb	Fatigue Pre-Cracking Max. Stress Intensity, K_{Ic} , psi $\sqrt{\text{in.}}$	Crack Length (a), In.	At 5 Per Cent Secant Offset Load (P ₀), lb	K_{Ic} , psi $\sqrt{\text{in.}}$	Minimum Thickness, K_{Ic} , psi $\sqrt{\text{in.}}$	Meaningful K_{Ic}	Fracture Appearance at Notch
7075-T652	2x8	341037	3	1.499	0.7528	251	6 200	0.753	2 275	27 700	0.279	Yes	30
		341038	3	1.500	0.7501	251	6 000	0.733	2 275	25 400	0.320	Yes	10
		341039	3	1.499	0.7509	251	7 700	0.845	2 140	30 800	0.468	Yes	35
		341040	3	2.000	0.9999	504	7 800	1.022	3 480	27 100	0.389	Yes	5
		341041	3	2.000	0.9991	504	7 700	1.015	3 590	27 700	0.405	Yes	2
		341042	3	2.002	0.9990	504	7 700	1.015	3 440	26 400	0.368	Yes	2
		341043	3	2.001	0.9980	504	7 300	0.963	2 970	21 100	0.298	Yes	0
		341044	3	2.001	0.9985	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341045	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341046	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341047	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341048	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341049	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341050	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341051	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341052	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341053	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341054	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341055	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341056	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341057	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341058	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341059	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341060	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341061	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341062	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341063	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341064	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341065	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341066	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341067	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341068	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341069	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341070	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341071	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341072	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341073	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341074	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341075	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341076	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341077	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341078	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341079	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341080	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341081	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341082	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341083	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341084	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341085	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341086	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341087	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341088	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341089	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341090	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341091	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341092	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341093	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341094	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341095	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341096	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341097	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341098	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341099	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341100	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341101	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341102	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341103	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341104	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341105	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341106	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341107	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341108	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341109	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341110	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341111	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341112	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341113	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341114	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341115	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341116	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341117	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341118	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341119	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341120	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341121	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341122	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341123	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341124	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341125	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341126	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341127	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341128	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341129	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341130	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341131	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341132	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes	0
		341133	3	2.001	1.0000	504	8 000	1.032	2 970	20 500	0.284	Yes</	

Table VIII

TABLE VIII

RESULTS OF LONG-TRANSVERSE AXIAL-STRESS FATIGUE TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS (R=0.0)
(F33615-68-C-1385)

Alloy and Temper	Sample		Cycles to Failure		
	Size, In.	Number			
	Maximum Stress, psi		<u>60 000</u>	<u>40 000</u>	<u>35 000</u>
2014-T652	2x8	341007	34 200	4 358 100	10 264 500*
	4x8	341009	17 700	1 032 800	6 252 200
	5x10	341012	18 900	230 000	10 017 300*
	6x12	341015	7 700	142 200	14 323 200*
	Log-Mean Fatigue Life		17 200	619 400	---
2024-T852	2x8	341017	22 600	252 900	10 029 500*
	4x8	341019	12 700	180 700	19 845 700*
	5x10	341022	14 300	90 200	17 189 300*
	6x12	341015	7 200	93 600	14 882 400*
	Log-Mean Fatigue Life		13 700	140 200	---
	Maximum Stress, psi		<u>60 000</u>	<u>45 000</u>	<u>38 000</u>
7075-T7352	2x8	341027	28 100	4 084 800	14 882 600*
	4x8	341029	4 700	82 400	1 455 800
	5x10	341032	9 800	51 100	105 800
	6x12	341035	3 600	38 600	93 000
	Log-Mean Fatigue Life		8 300	160 500	---
7079-T652	2x8	341037	22 200	109 800	720 500
	4x8	341039	22 700	61 400	11 607 400*
	5x10	341042	19 200	75 500	162 700
	6x12	341045	11 400	40 200	146 400
	Log-Mean Fatigue Life		18 100	66 900	---

* Specimen did not fail.

TABLE IX

STATUS OF LONGITUDINAL AND LONG-TRANSVERSE STRESS-CORROSION TESTS
TRIPPLICATE 0.437" DIAMETER TENSION SPECIMENS STRESSED IN DIRECT TENSION *

Alloy and Temper	Forging Size, In.	Sample Number	Exposure: 3.5% NaCl Solution by Alternate Immersion			
			Longitudinal Specimens		Long-Transverse Specimens	
			Stressed 7 1/2% Y.S. F/Nt	Days	Stressed 7 1/2% Y.S. F/Nt	Days
2014-T652	2 x 8	341007	0/3	OK - 164	3/3	8, 59, 64 OK - 164
	4 x 16	341010	0/3	OK - 48	0/3	OK - 48
	6 x 24	341016	0/3	OK - 12	0/3	OK - 12
2024-T052	2 x 8	341017	0/3	OK - 164	0/3	OK - 164
	4 x 16	341020	0/3	OK - 48	0/3	OK - 48
	6 x 24	341026	0/3	OK - 12	0/3	OK - 12
7075-T7352	2 x 8	341027	0/3	OK - 164	0/3	OK - 164
	4 x 16	341030	0/3	OK - 48	0/3	OK - 48
	6 x 24	341036	0/3	OK - 12	0/3	OK - 12
7079-T652	2 x 8	341037	0/3	OK - 164	3/3	27, 59, 64 OK - 164
	4 x 16	341040	0/3	OK - 48	2/3	20, 26 (1-OK-48) OK - 48
	6 x 24	341046	0/3	OK - 12	0/3	OK - 12

* Duplicate unstressed specimens were also exposed in each instance.

+ F/N denotes number of specimens failed over number exposed.

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TABLE X

**STATUS OF SHORT-TRANSVERSE STRESS-CORROSION TESTS
TRIPPLICATE 0.25" DIAMETER TENSION SPECIMENS STRESSED IN DIRECT TENSION***

Alloy and Temper	Forging Size, In.	Sample Number	Str. 12% Y.S.			Str. 22% Y.S.			Exposure: 3.5% NaCl Solution by Alternate Immersion			Str. 22% Y.S.			Str. 12% Y.S.		
			F/N†	Days	Days	F/N†	Days	Days	F/N†	Days	Days	F/N†	Days	Days	F/N†	Days	Days
2014-T652	2 x 8	341007	---	---	---	---	---	---	1/3	OK - 4	OK - 24	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24
	2 x 12	341008	---	---	---	---	---	---	1/3	1, 2, 8	34(2-OK-24)	1/3	1, 2, 8	OK - 24	1/3	OK - 24	OK - 24
	4 x 16	341010	---	---	---	---	---	---	1/3	4, 4, 4	0(2-OK-48)	1/3	4, 4, 4	K - 48	1/3	K - 48	K - 48
	5 x 20	341013	---	---	---	---	---	---	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24
	6 x 24	341016	---	---	---	---	---	---	1/3	4, 4, 5	OK - 5	1/3	OK - 5	OK - 5	1/3	OK - 5	OK - 5
	2 x 8	341017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2024-T352	3 x 12	341018	---	---	---	---	---	---	1/3	OK - 4	OK - 4	1/3	OK - 4	OK - 4	1/3	OK - 4	OK - 4
	4 x 16	341020	---	---	---	---	---	---	1/3	3, 2, 4	10(2-OK-48)	1/3	3, 2, 4	OK - 4	1/3	OK - 4	OK - 4
	5 x 20	341023	---	---	---	---	---	---	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24
	6 x 24	341026	---	---	---	---	---	---	1/3	OK - 5	OK - 5	1/3	OK - 5	OK - 5	1/3	OK - 5	OK - 5
	2 x 8	341027	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	3 x 12	341028	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7075-T7352	4 x 16	341030	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	5 x 20	341033	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	6 x 24	341036	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	2 x 8	341037	---	---	---	---	---	---	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24
	3 x 12	341038	---	---	---	---	---	---	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24
	4 x 16	341040	---	---	---	---	---	---	1/3	3, 4, 4	4, 4, 4	1/3	4, 4, 4	5, 2, 2	1/3	5, 2, 2	5, 2, 2
7075-T652	5 x 20	341043	---	---	---	---	---	---	2/3	15, 27(1-OK-24)	OK - 24	1/3	OK - 24	OK - 24	1/3	OK - 24	OK - 24
	6 x 24	341046	---	---	---	---	---	---	2/3	5, 5(1-OK-5)	OK - 5	1/3	OK - 5	OK - 5	1/3	OK - 5	OK - 5

* Duplicate unstressed specimens were also exposed in each instance.

† F/N denotes number of specimens failed over number exposed.

Specimens failed outside the reduced section, beneath the protective coating used to isolate all parts of the stressing frame.

\$ Forging to be re-tested to confirm anomalous results.

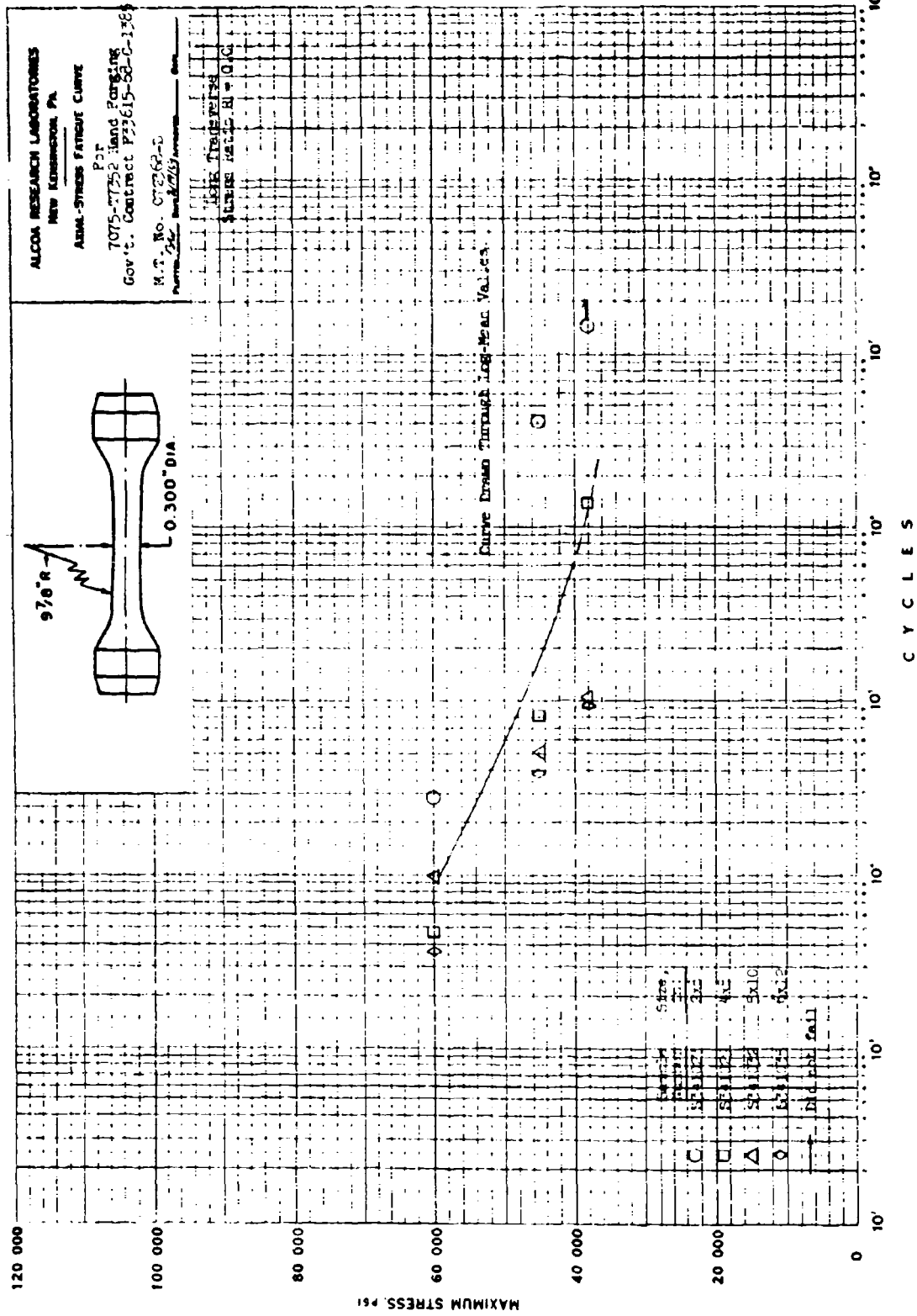


Fig. 1

Long Transverse Brittle, Constant Load Tests
 S-3416, 6 x 24 in.
 Contract F3515-58-C-1385

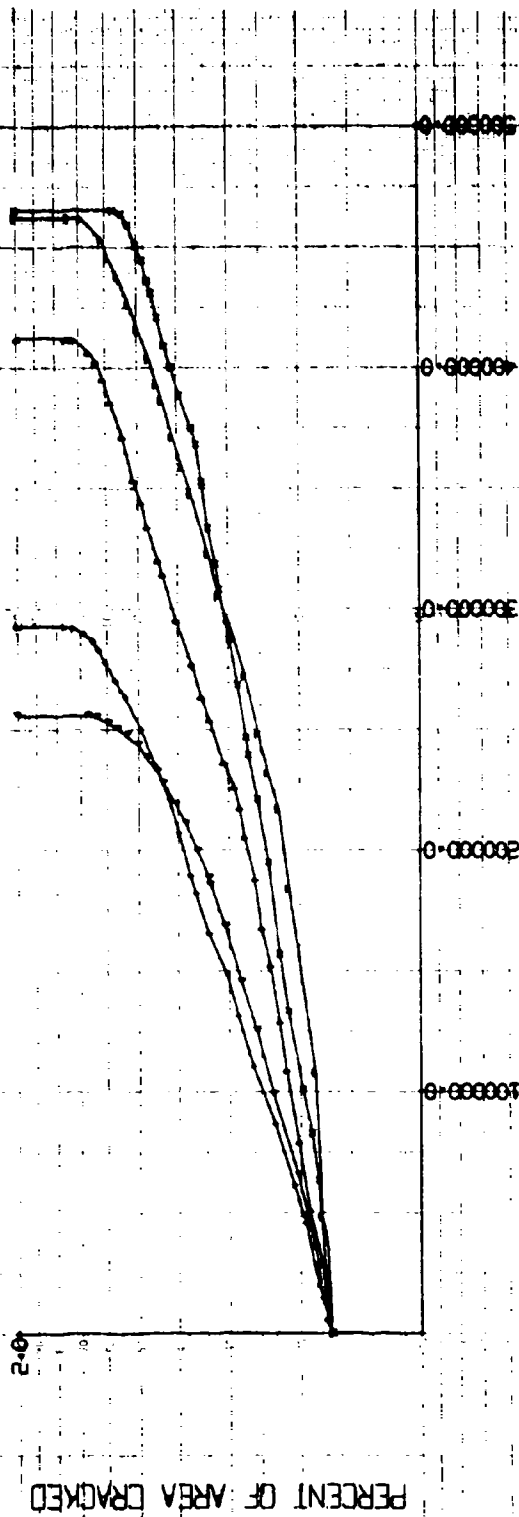
Legend:

Spec.	Max. Gross Stress, ksi	Range of Humidity, %
1	8.2	8-38
4	8.2	3-25
2	8.2	4-38
5	8.2	4-25
4	8.2	22-54
18	8.2	

"Sharp" Notch

4-38
 4-25
 22-54

R = 1/3



EFFECT OF SHAPE OF NOTCH ON FATIGUE CRACK PROPAGATION
 OF 2014-T652 FORGINGS AT A GROSS STRESS OF 8.2 ksi

FIG. 2

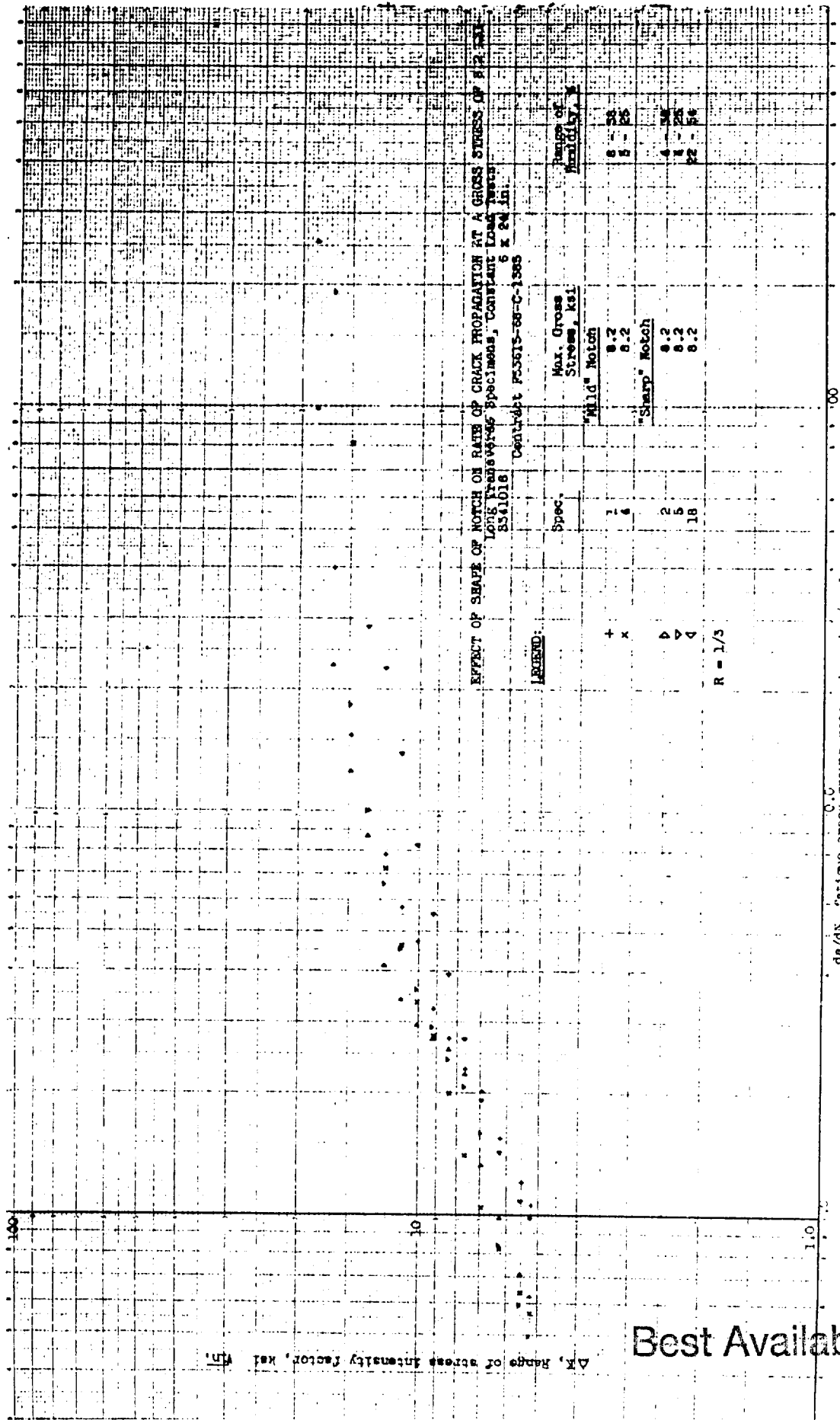


Fig. 3

Long Transverse Specimens, Constant Load Tests

5 541015, 6 x 24 in.

Contract F33615-58-F-1386

Legend:

Max. Gross
Stress, ksi

Range of
Humidity, %

"Mild" Notch

"Sharp" Notch

8-11

5-8

8-46

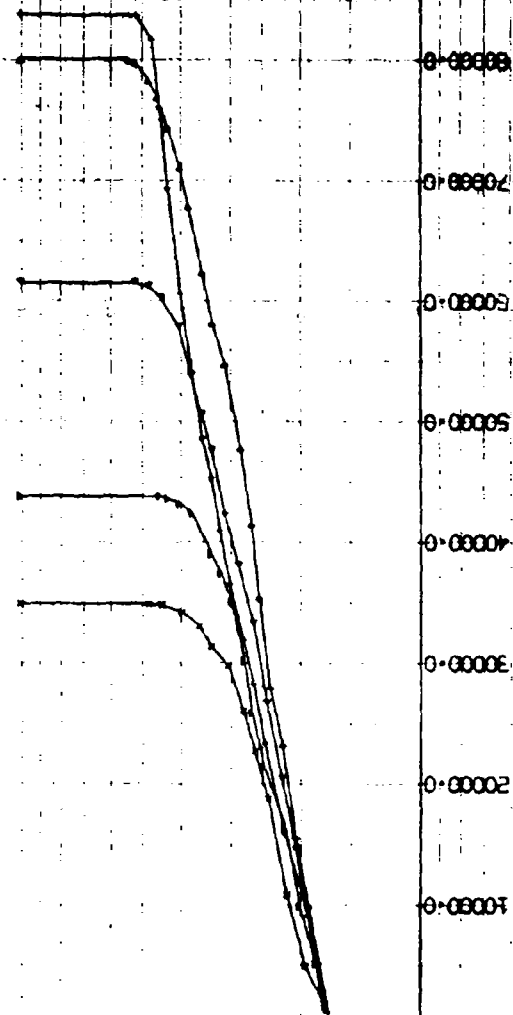
7-8

10-16

R = 1/5

LOG PERCENT OF AREA CRACKED

2-0

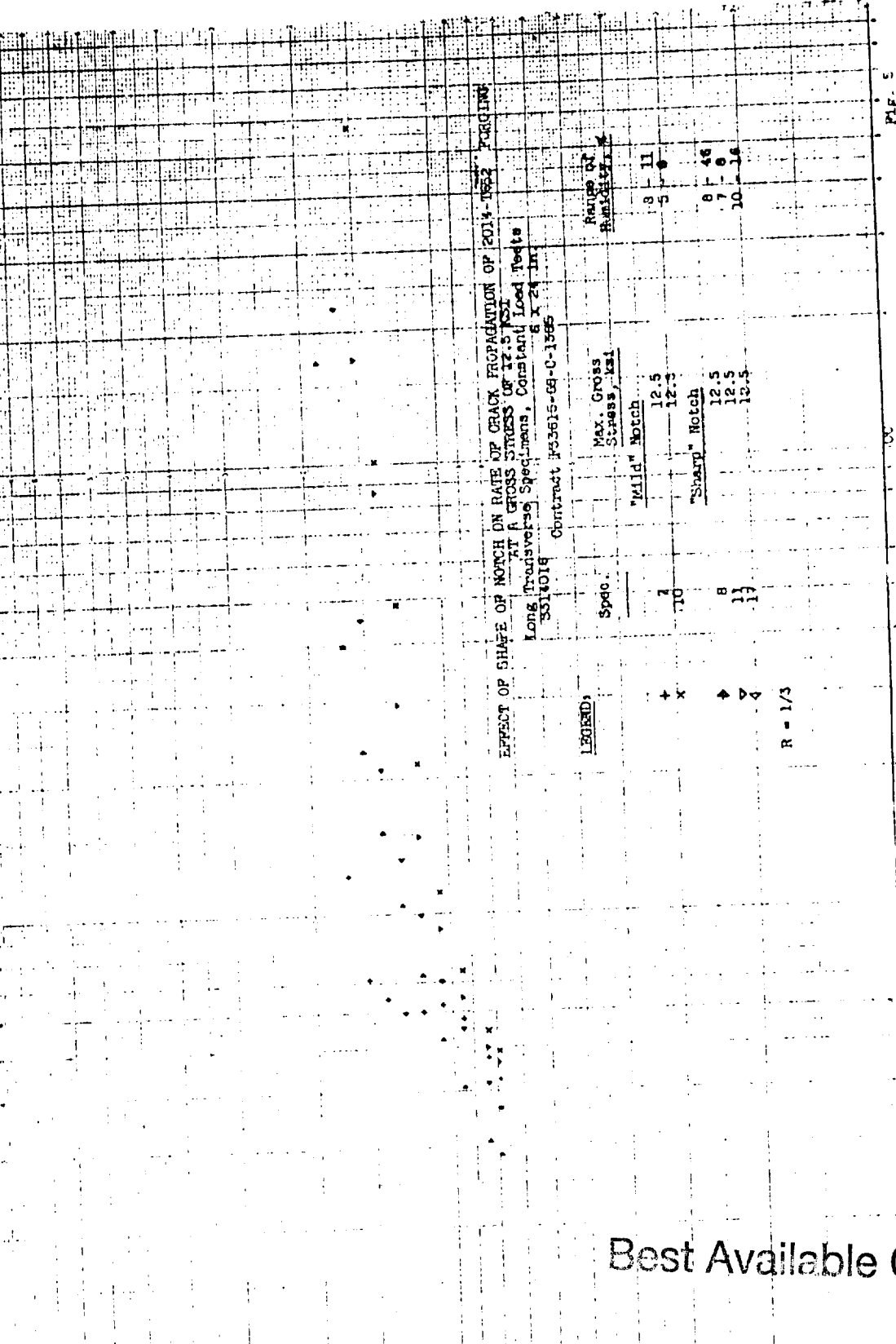


CYCLES

EXPOSURE OF CRACKS OF NOTCH ON FATIGUE CRACK PROPAGATION OF 2014-T852 FORGINGS
AT A GROSS STRESS OF 12.5 KSI

Fig. 1

ΔK , Range of stress intensity factor, ksi



LEGEND:

Max. Gross Stress, ksi

Spd.

Notch

Range of ΔK , ksi√in

Max. Gross Stress, ksi	Spd.	Notch	Range of ΔK , ksi√in
12.5	1	"Mild"	8 - 11
12.5	10	"Mild"	5 - 8
12.5	8	"Sharp"	8 - 48
12.5	11	"Sharp"	7 - 8
12.5	11	"Sharp"	10 - 16

R = 1/3

da/dN, fatigue crack growth rate, micro in./cycle

FIG. 5

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Long Transverse Specimens, Constant Load Tests
 S 341015, 6 x 24 in.
 Contract F3313-68-C-1385

Legend:

Symbol	Max. Gross Stress, ksi	Range of Humidity, %
+	8.2	4-38
x	8.2	4-25
o	8.2	22-54
△	8.2	4-14
△	8.2	6-23
△	8.2	27-50

R = 1/3

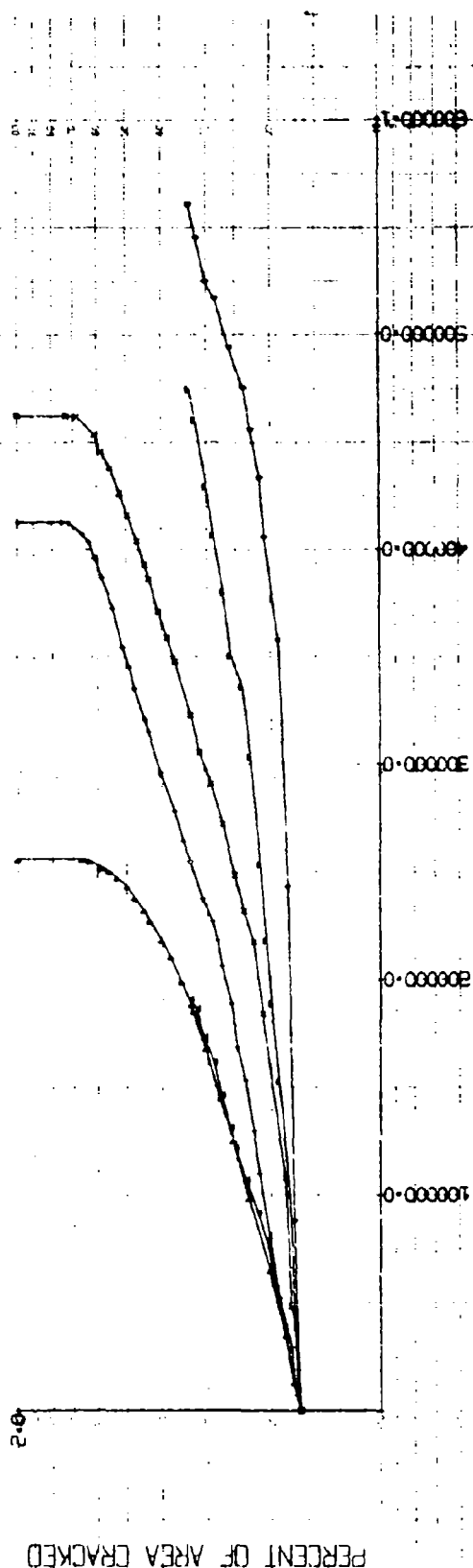
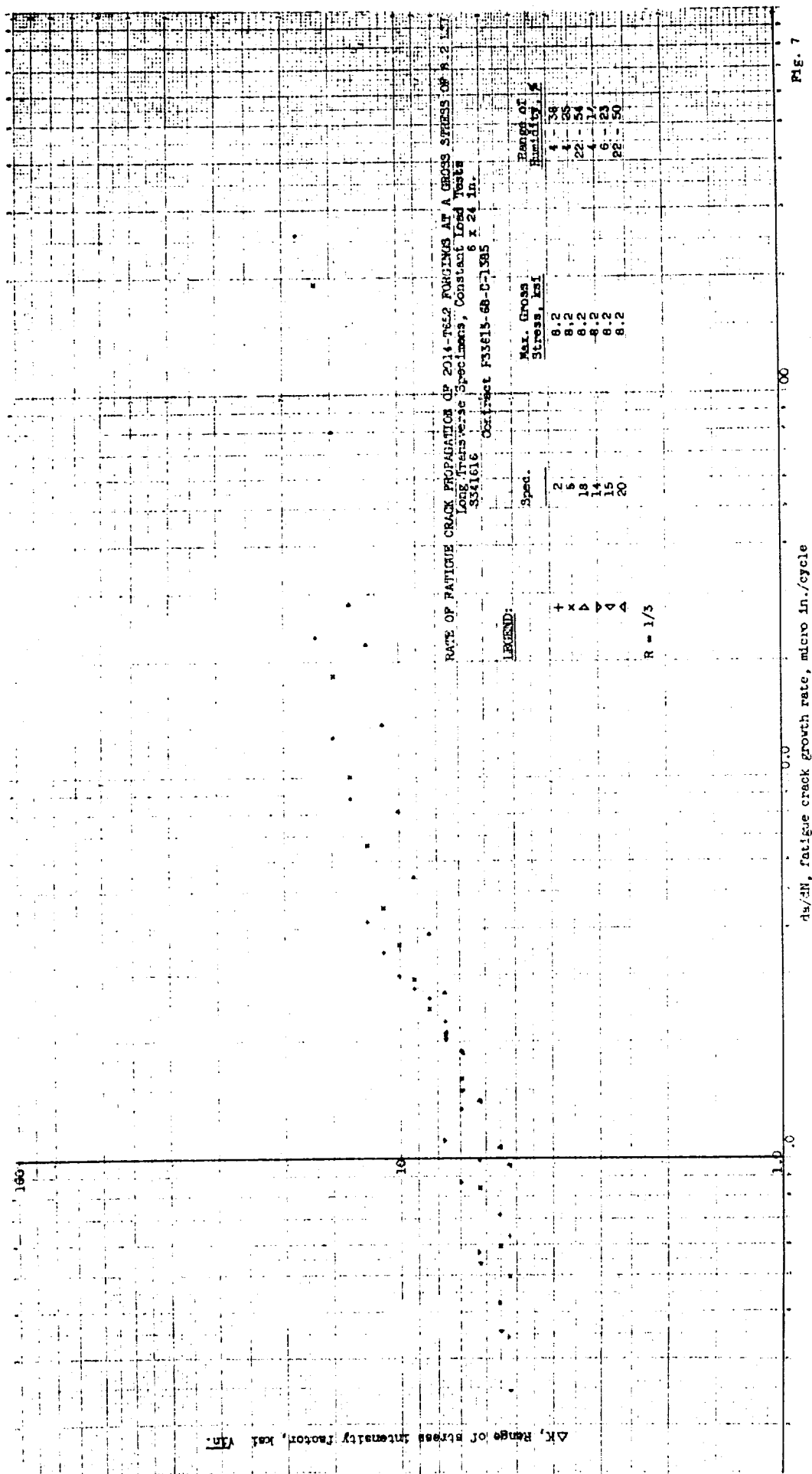


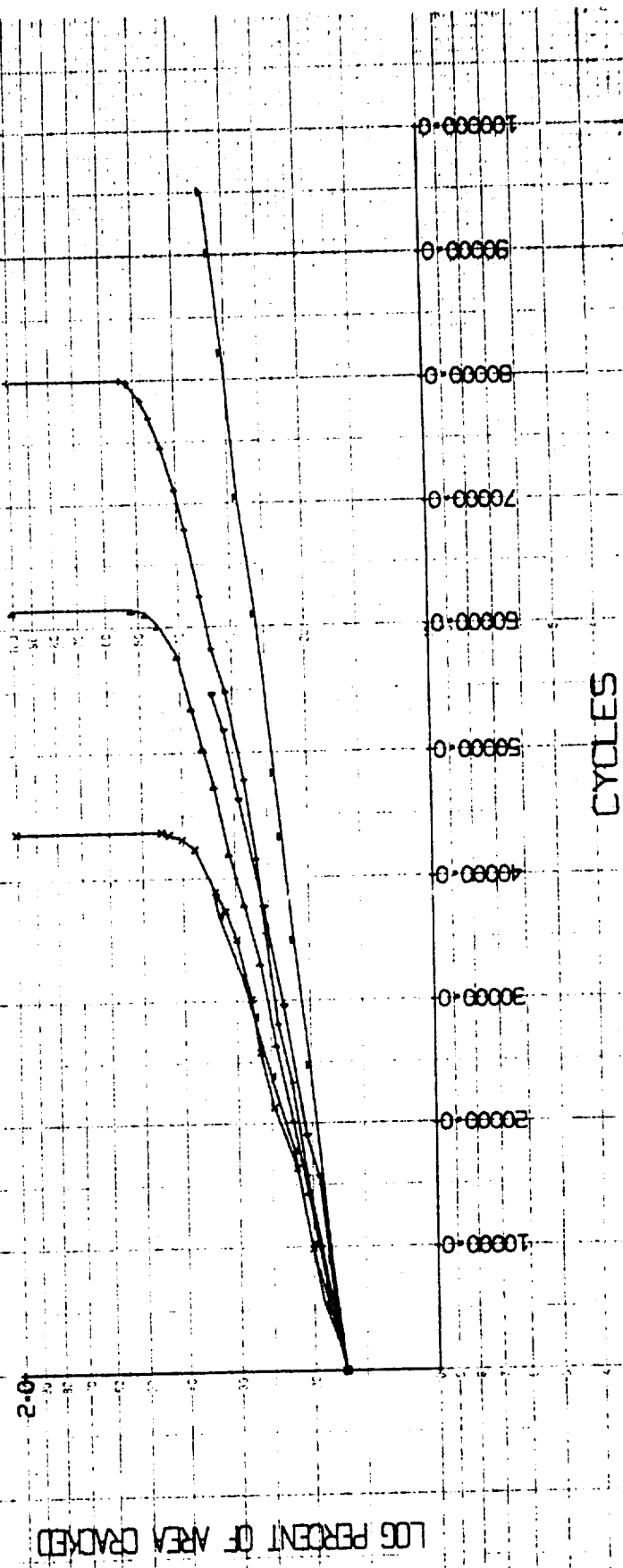
FIGURE 6
 FATIGUE CRACK PROPAGATION OF 2014-T652 FIBERGLASS
 AT A GROSS STRESS OF 8.2 ksi



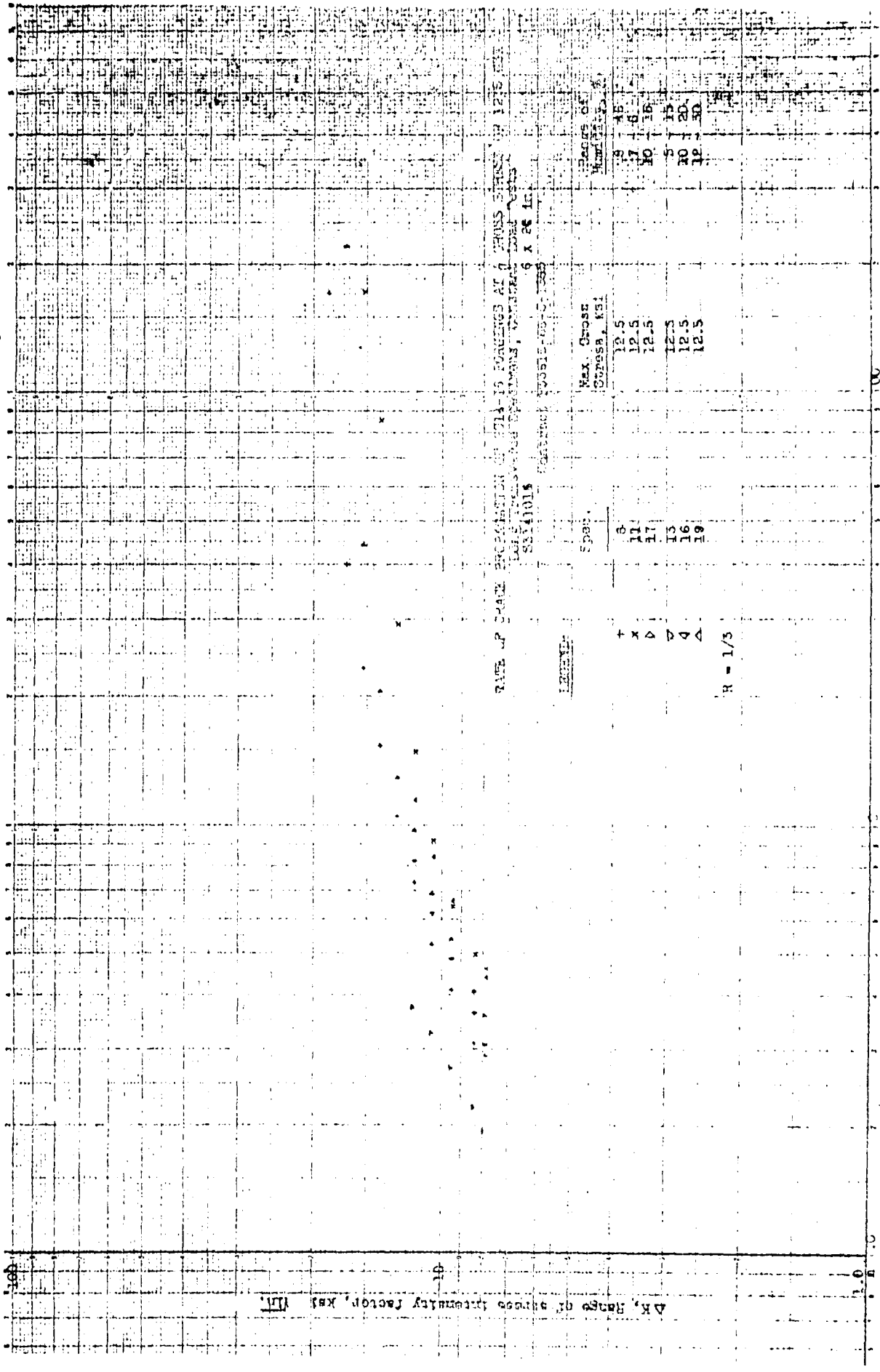
Long Transverse Specimens, Constant Load Rate
 341016, 4 x 24 in.
 Contract F33615-68-C-1485

Legend:	Spec.	Max. Gross Stress, ksi	Range of Humidity, %
+	8	12.5	8-46
x	11	12.5	7-8
o	17	12.5	10-16
△	13	12.5	5-15
□	16	12.5	10-20
△	19	12.5	12-30

R = 1/3



FATIGUE CRACK PROPAGATION OF 2014-T652 FORGINGS AT A GROSS STRESS OF 12.5 ksi



Long Transverse Specimens, Constant Load Tests
 S 341016, 6 x 24 in.
 Contract F33615-68-C-1385

Legend:

Spec.	Max. Gross Stress, ksi	Range of Humidity, %
+	8.2	4-38
x	8.2	4-25
o	8.2	22-54
6-in. Long Specimens		
▽	8.3	5-15
◇	8.3	3-23
R = 1/3		



CYCLES

EFFECT OF SPECIMEN LENGTH ON FATIGUE CRACK PROPAGATION OF 2014-T652 FORGINGS, 8.2 ksi

Fig. 10

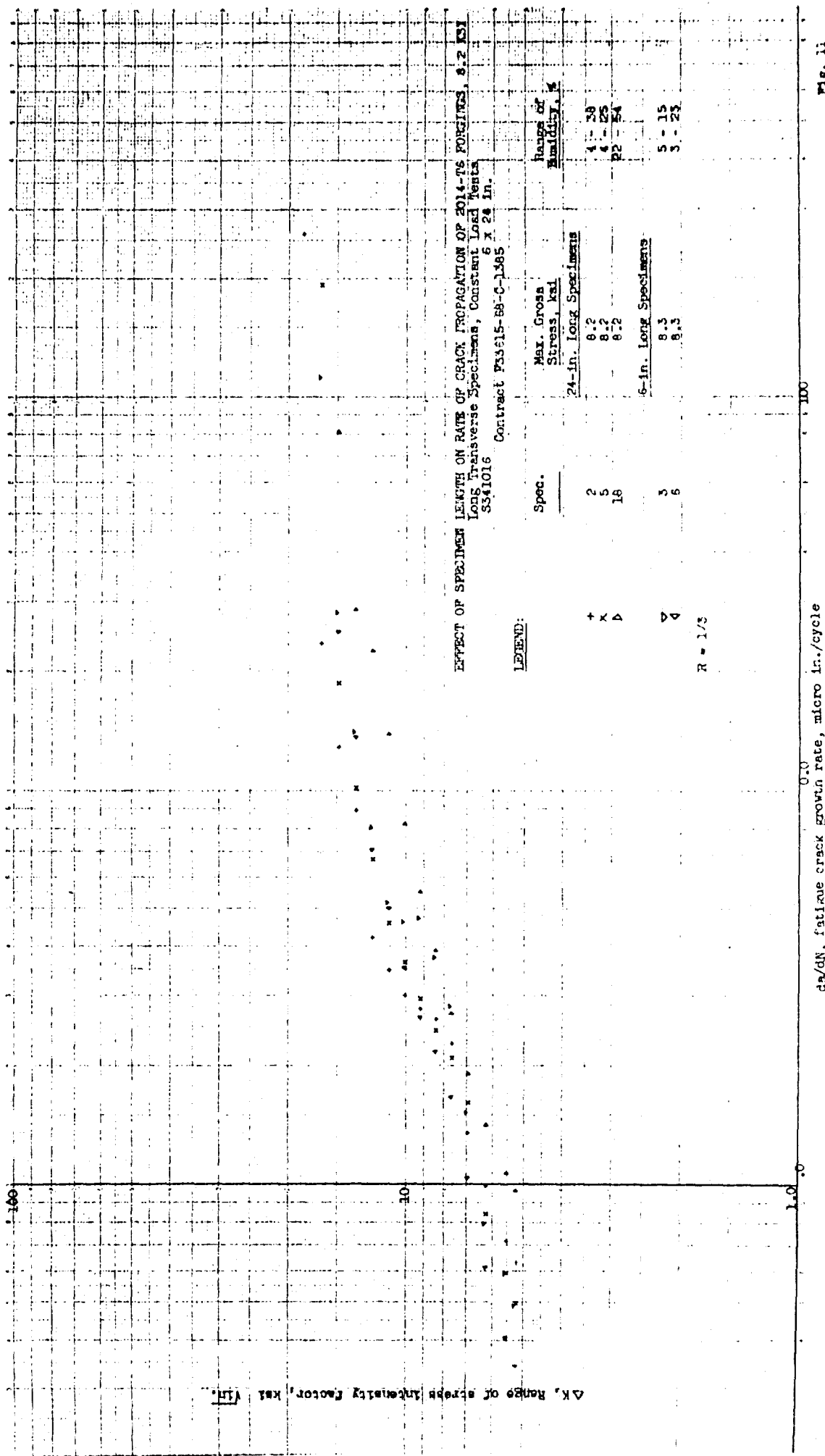


Fig. 11

Long Transverse Specimens, Constant Load Tests
 9-341016, 5 x 24 in.
 Contract F33615-68-C-1385

Legend:	Spec.	Max. Gross Stress, ksi	Range of Humidity, %
+	8	12.5	8-16
x	11	12.5	7-8
Δ	17	12.5	10-16
▽	9	12.5	4-16
◊	12	12.5	12-29

$R = 1/3$

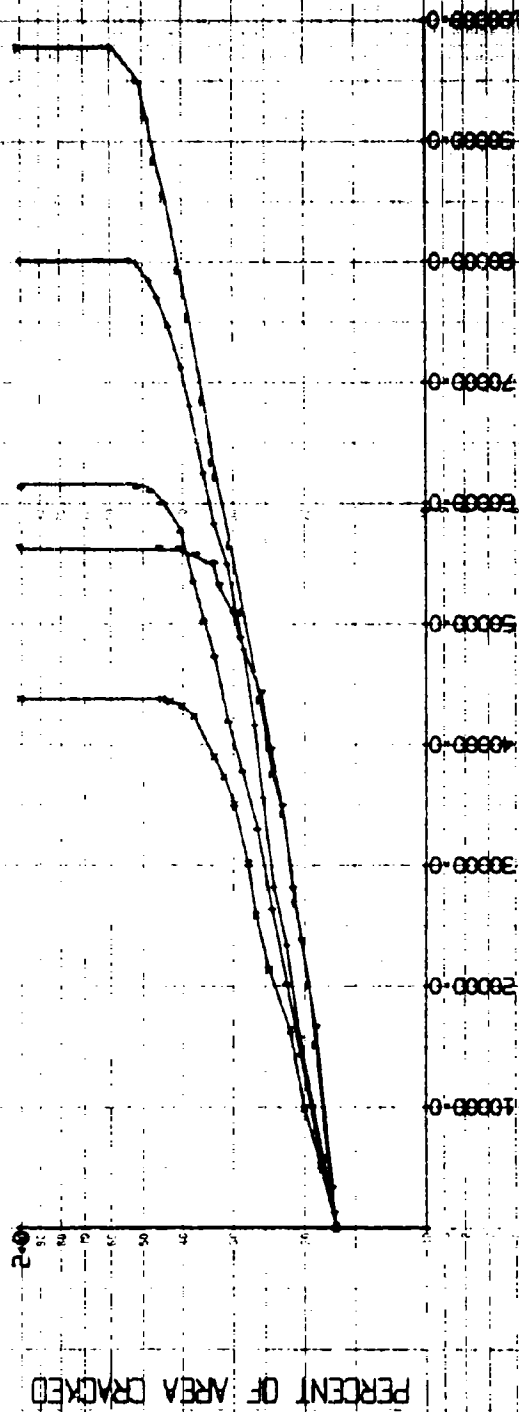


Fig. 12
 EFFECT OF SPECIMEN LENGTH ON FATIGUE CRACK PROPAGATION
 OF 2014-T352 FORGINGS, 12.5 ksi

Long Transverse Specimens, Constant Load Tests

S 341016, 6 x 24 in.
Contract F34115-68-C-185

Legend:

SPEC.	Max. Gross Stress, ksi		Range of Humidity, %
	To 1/2 in.	Beyond 1/2 in.	
+	14	8.2	12.5
x	15	8.2	12.5
Δ	20	8.2	12.5
▽	15	12.5	8.2
4	16	12.5	8.2
Δ	19	12.5	8.2

R = 1/2

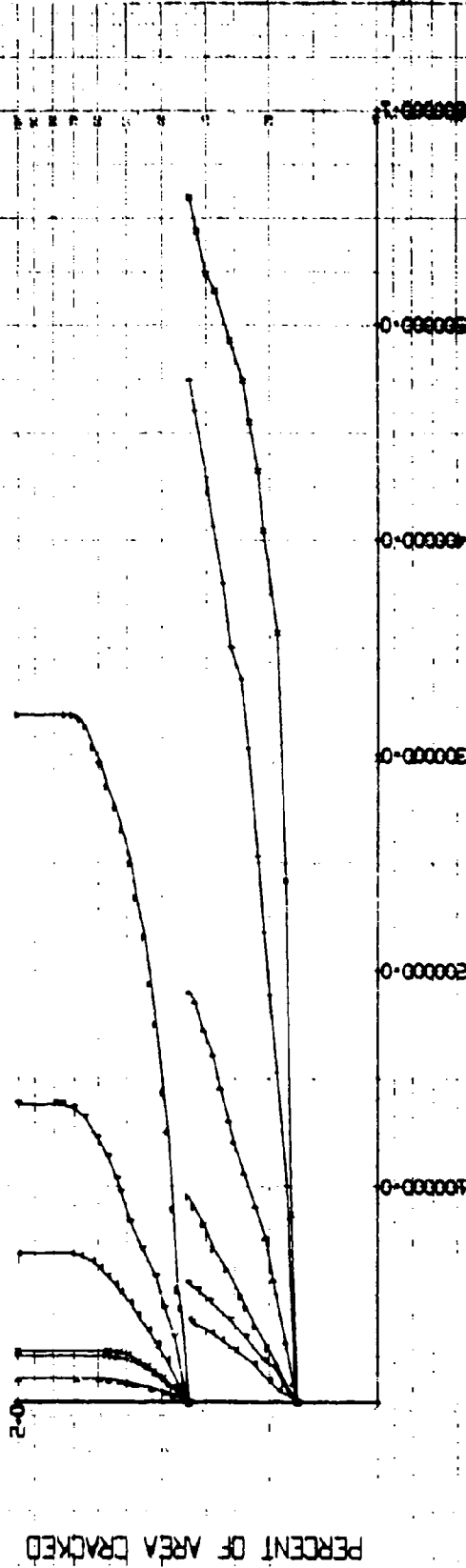
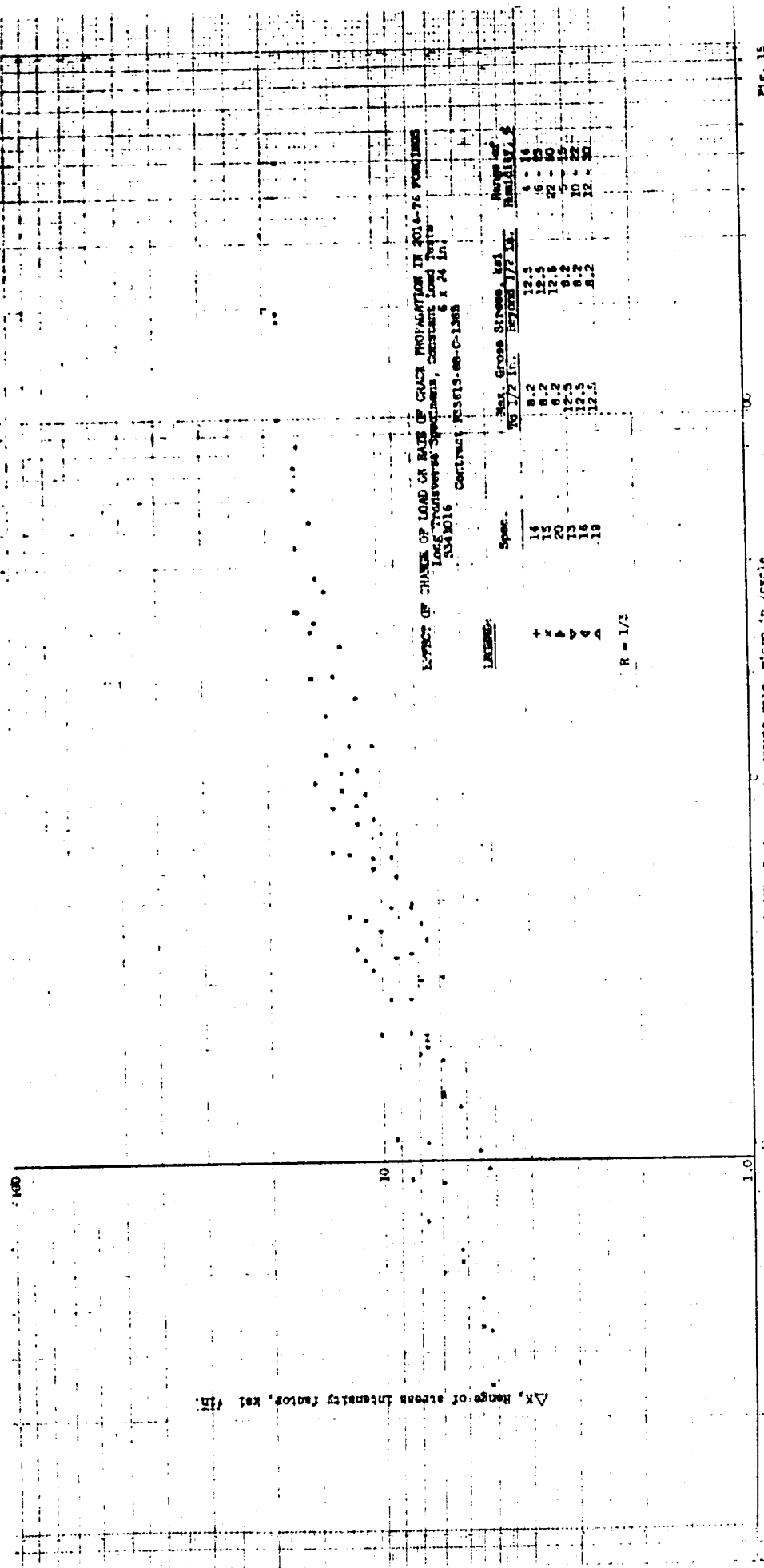
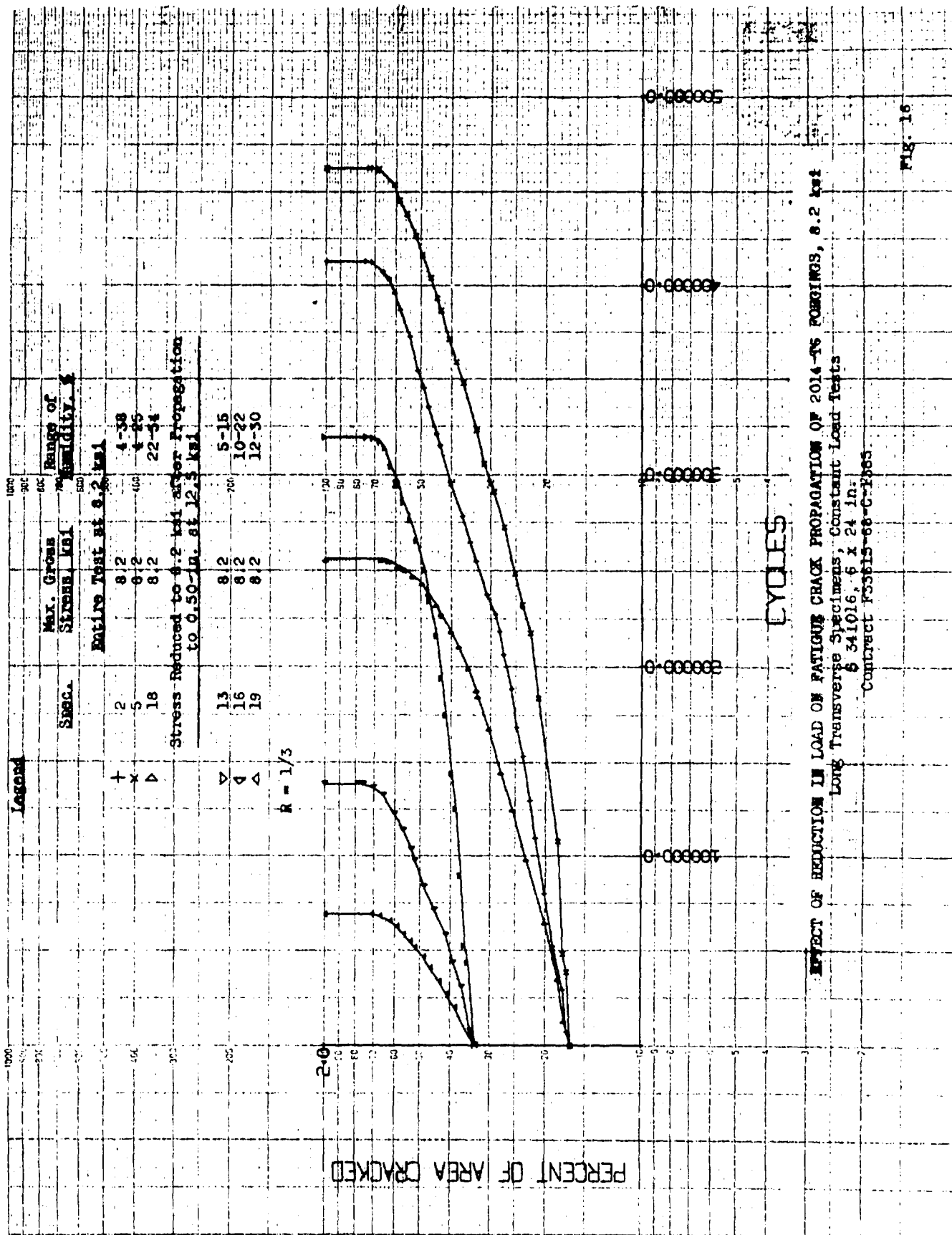
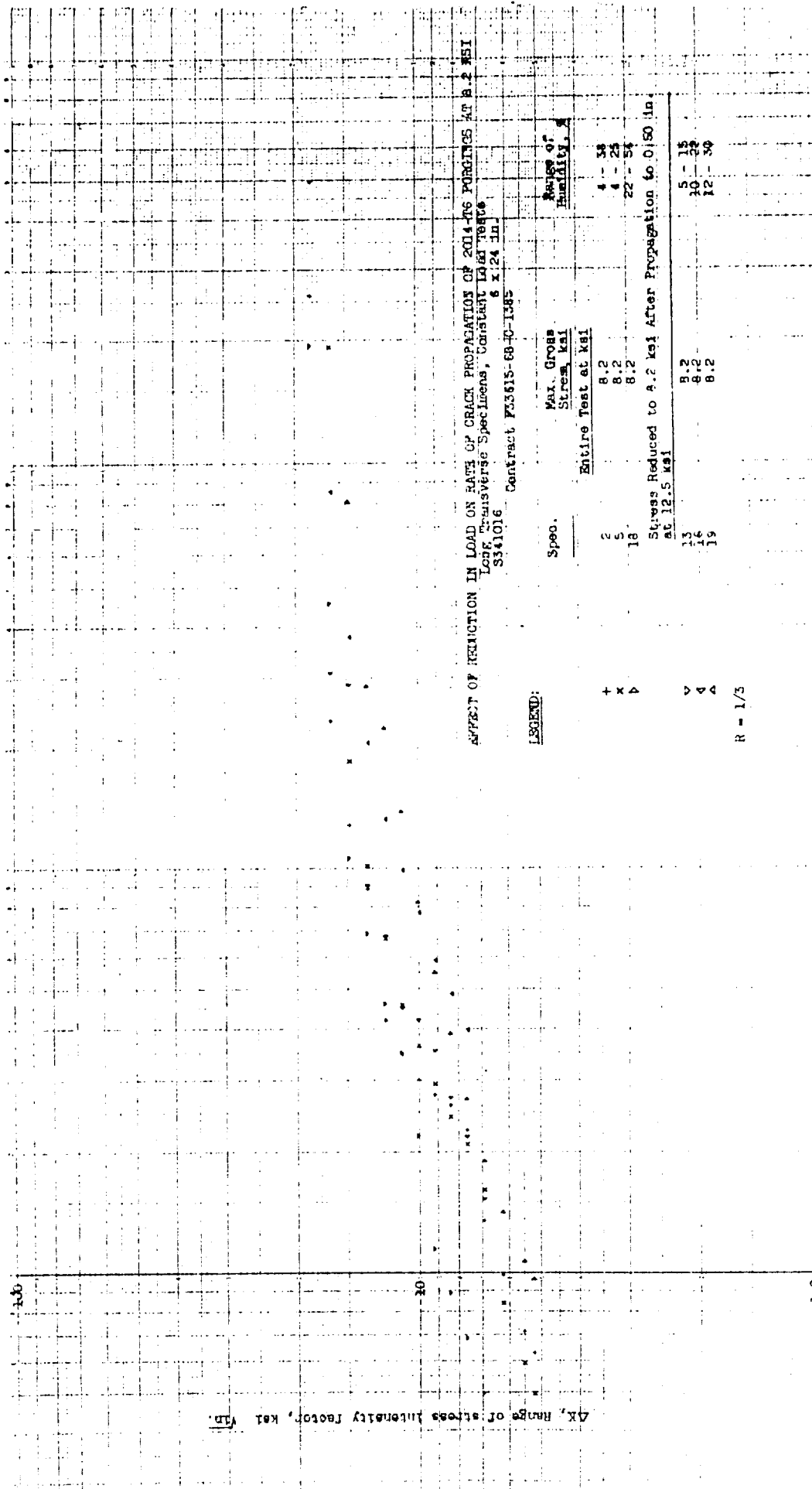


Fig. 16
EFFECT OF CHANGE IN LOAD ON FATIGUE CRACK PROPAGATION

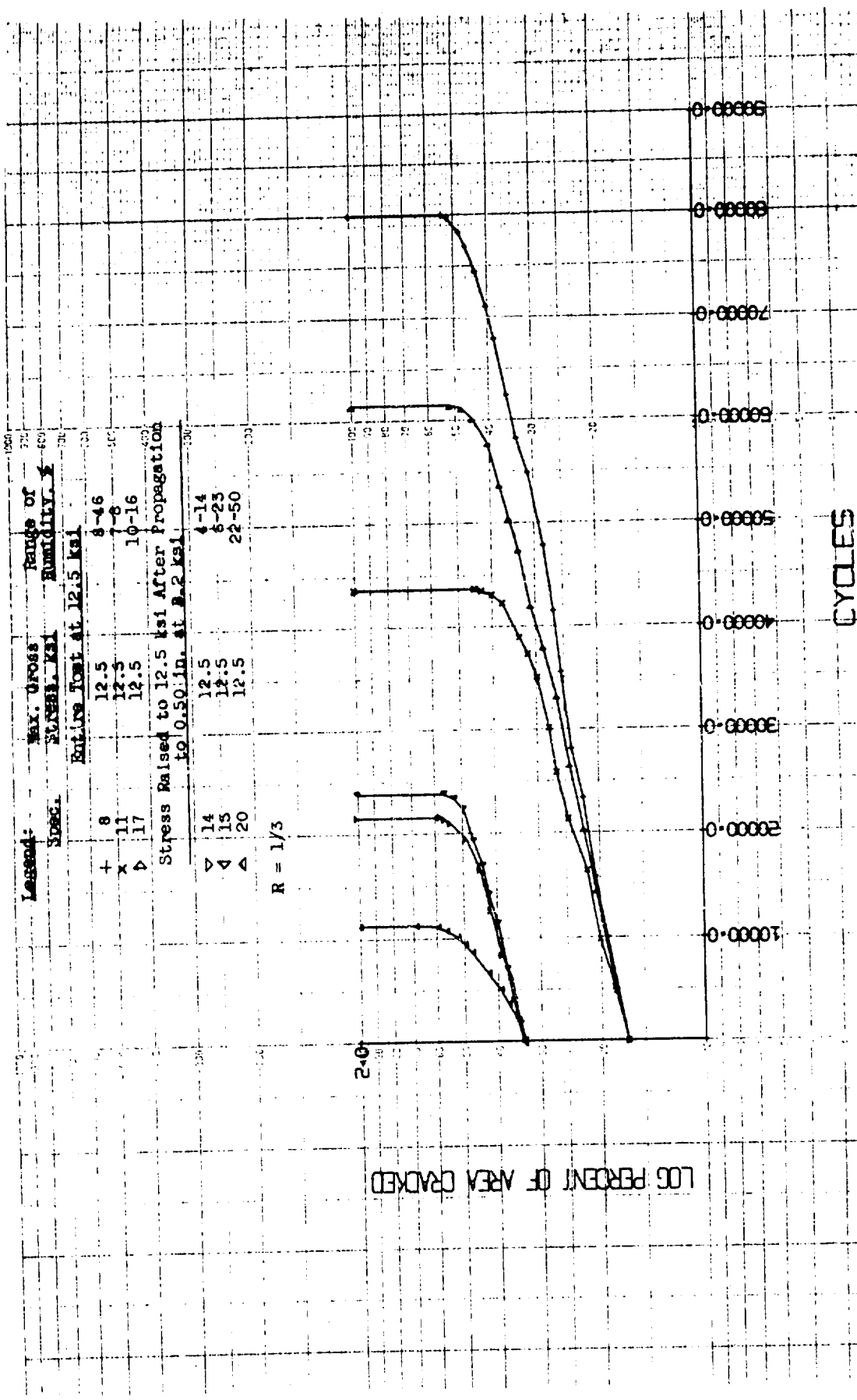


da/dN, fatigue crack growth rate, micro in./cycle





da/dN, fatigue crack growth rate, micro in./cycle



EFFECT OF INCREASE OF LOAD ON FATIGUE CRACK PROPAGATION
 Long Transverse Specimens, Constant Load Tests
 S 341016, 6 x 24 in.
 Contract F33615-68-C-1383

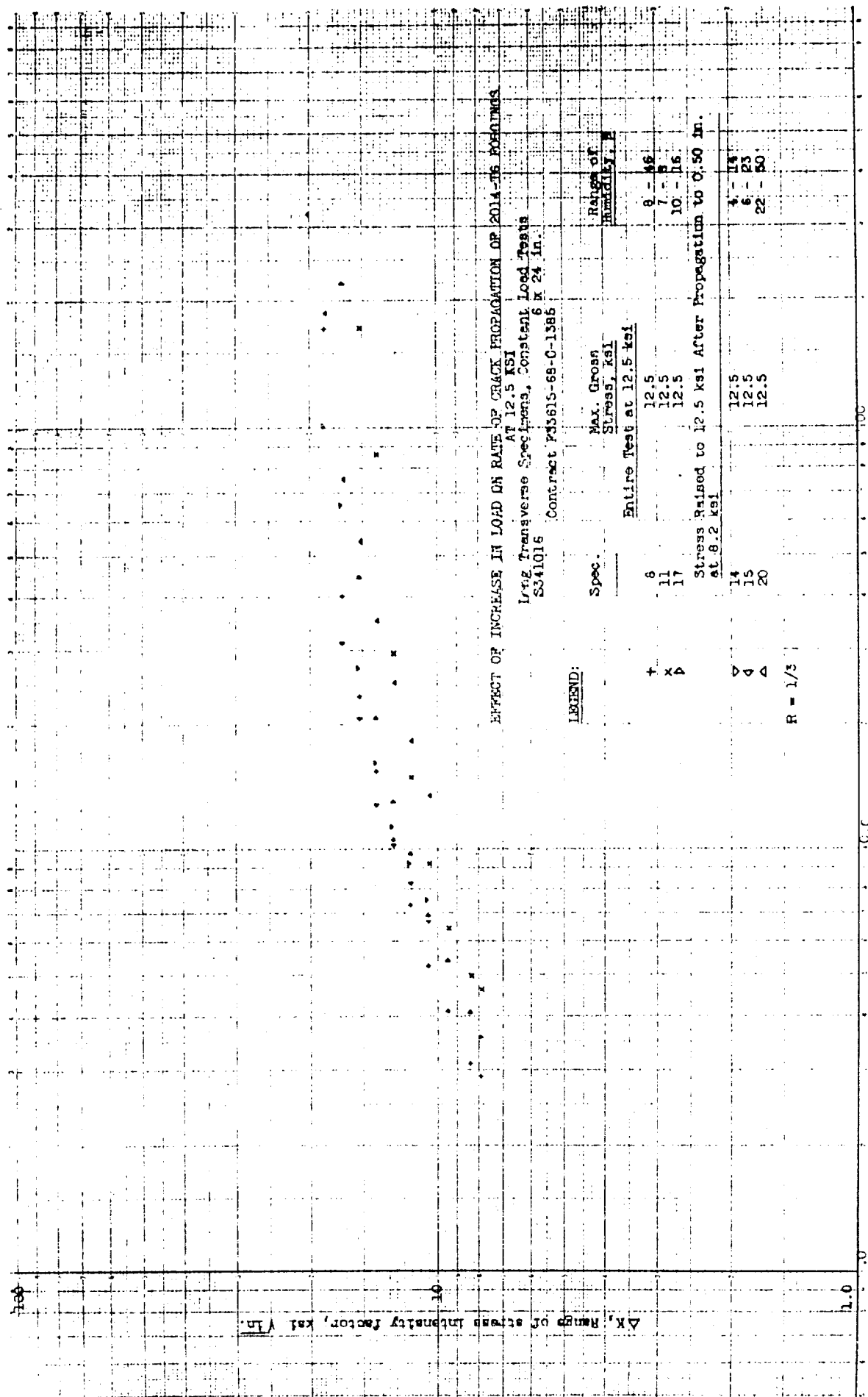


Fig. 19

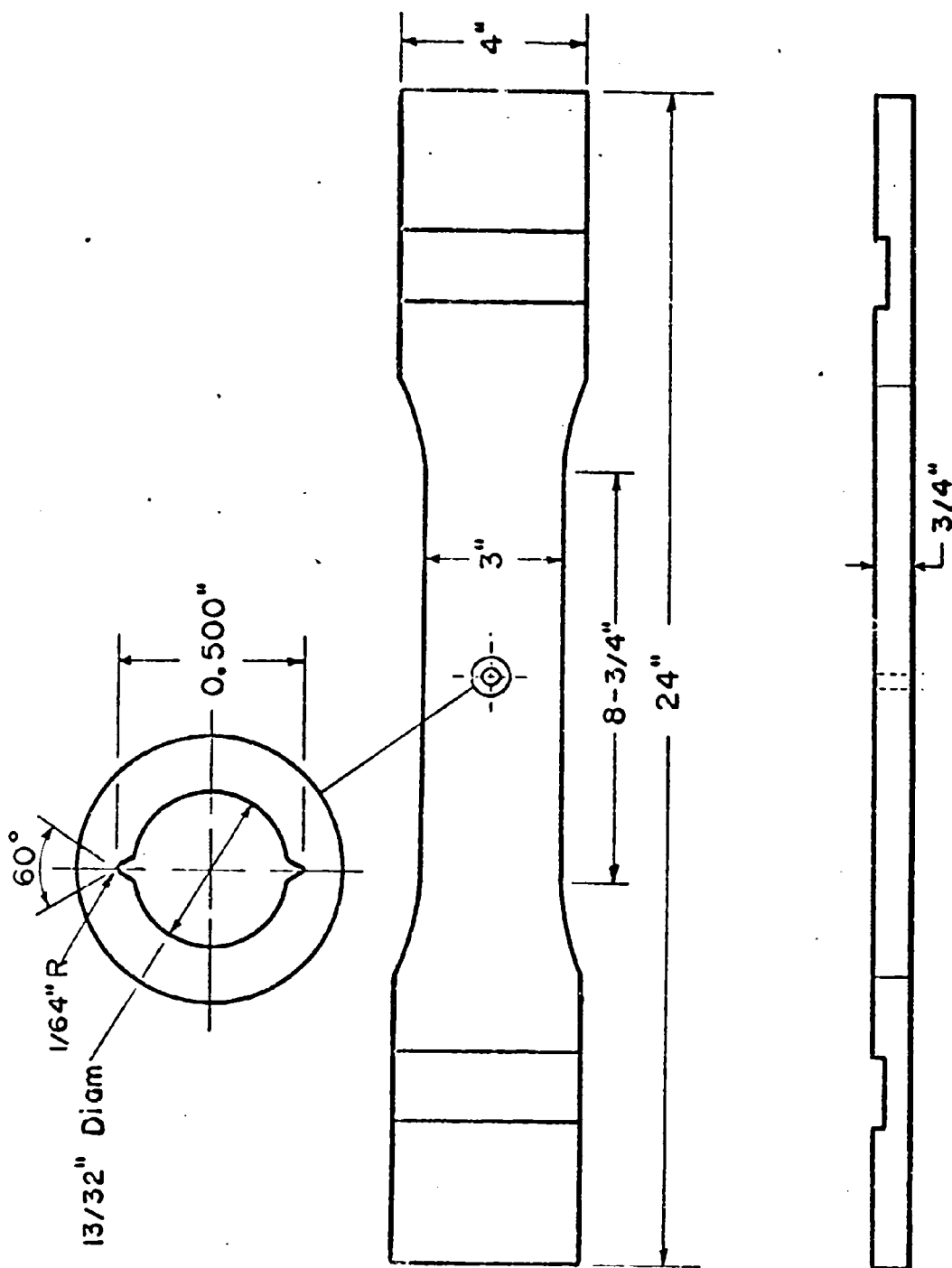


FIG. 20 CENTER-NOTCHED FATIGUE SPECIMENS
(MILD NOTCH)

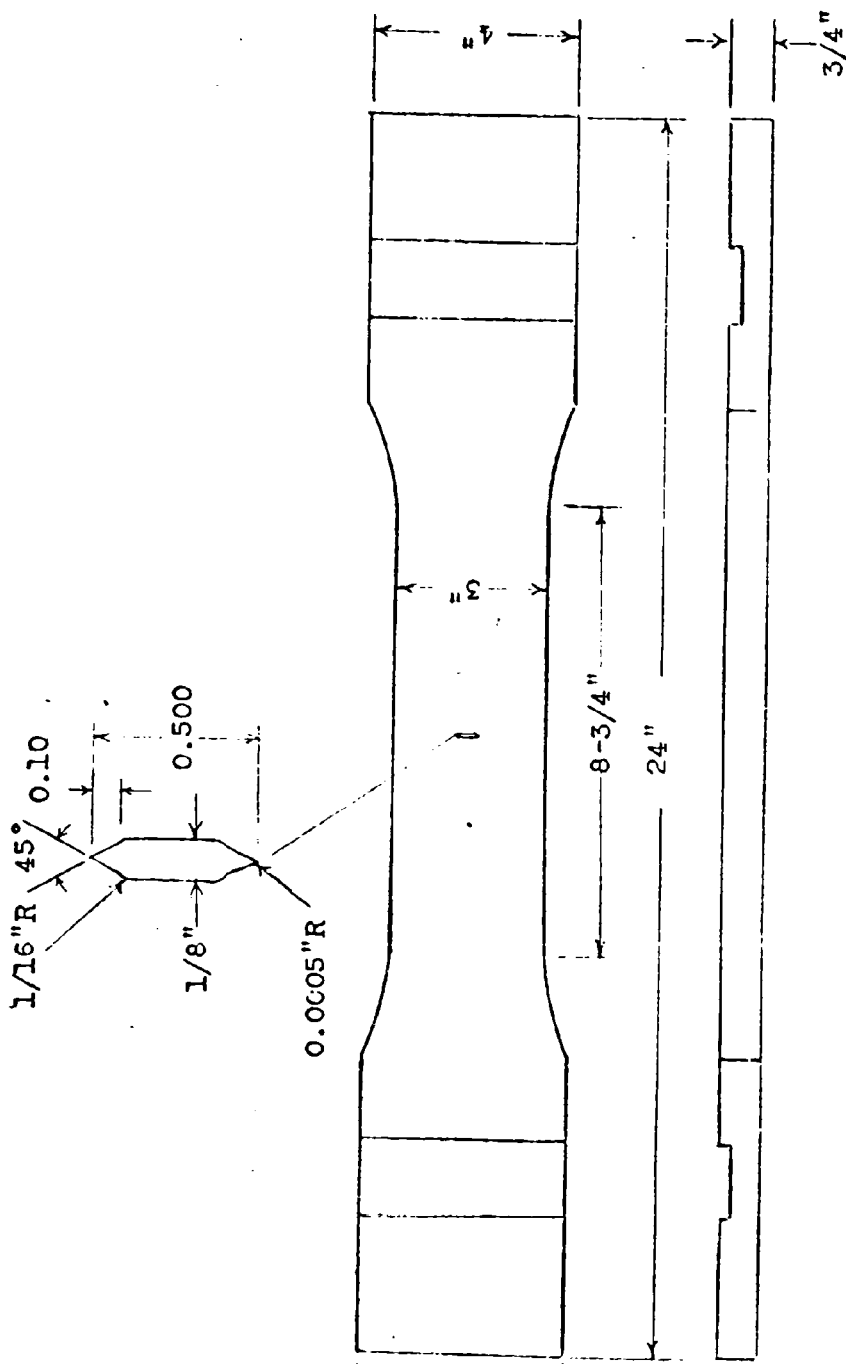
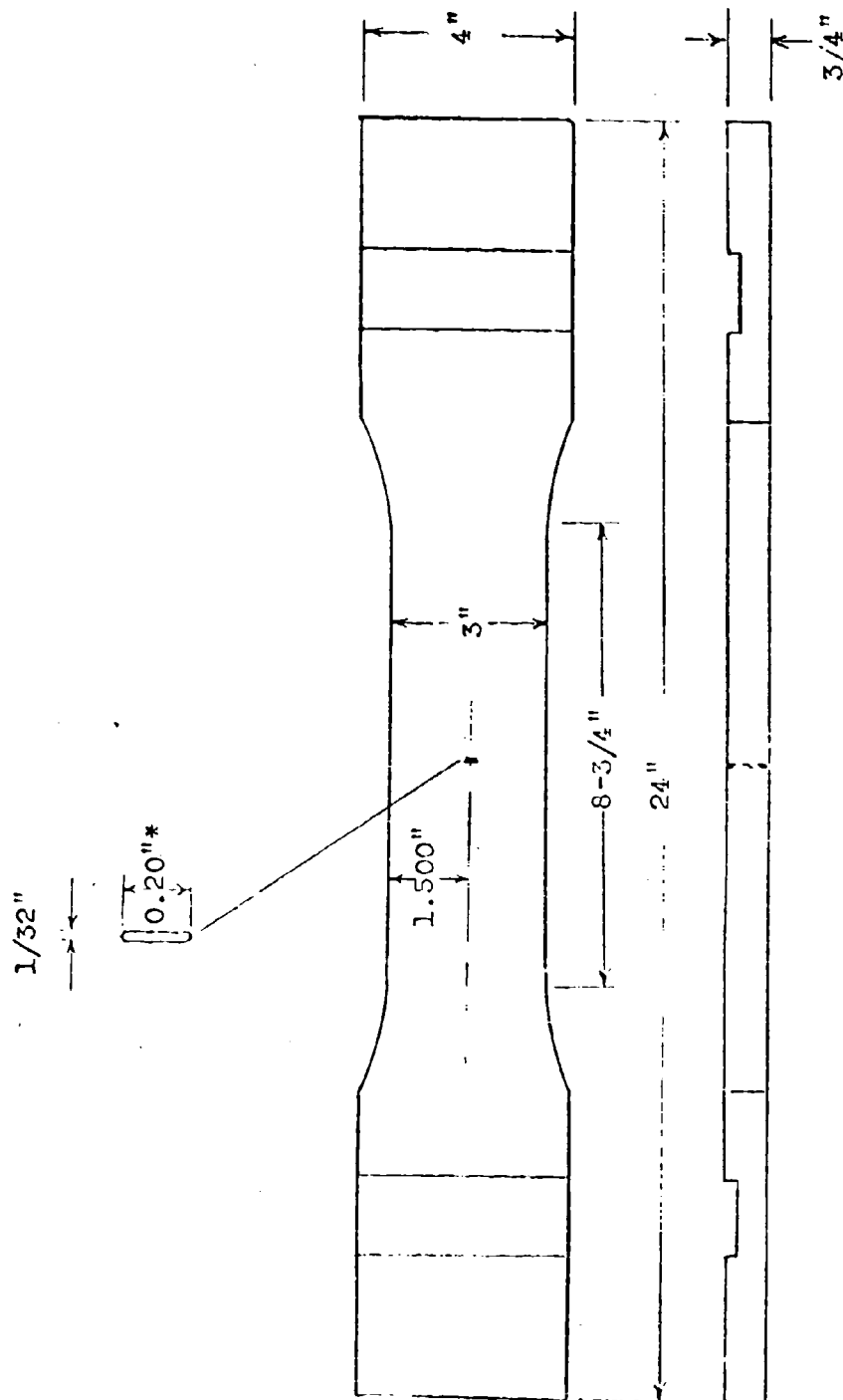
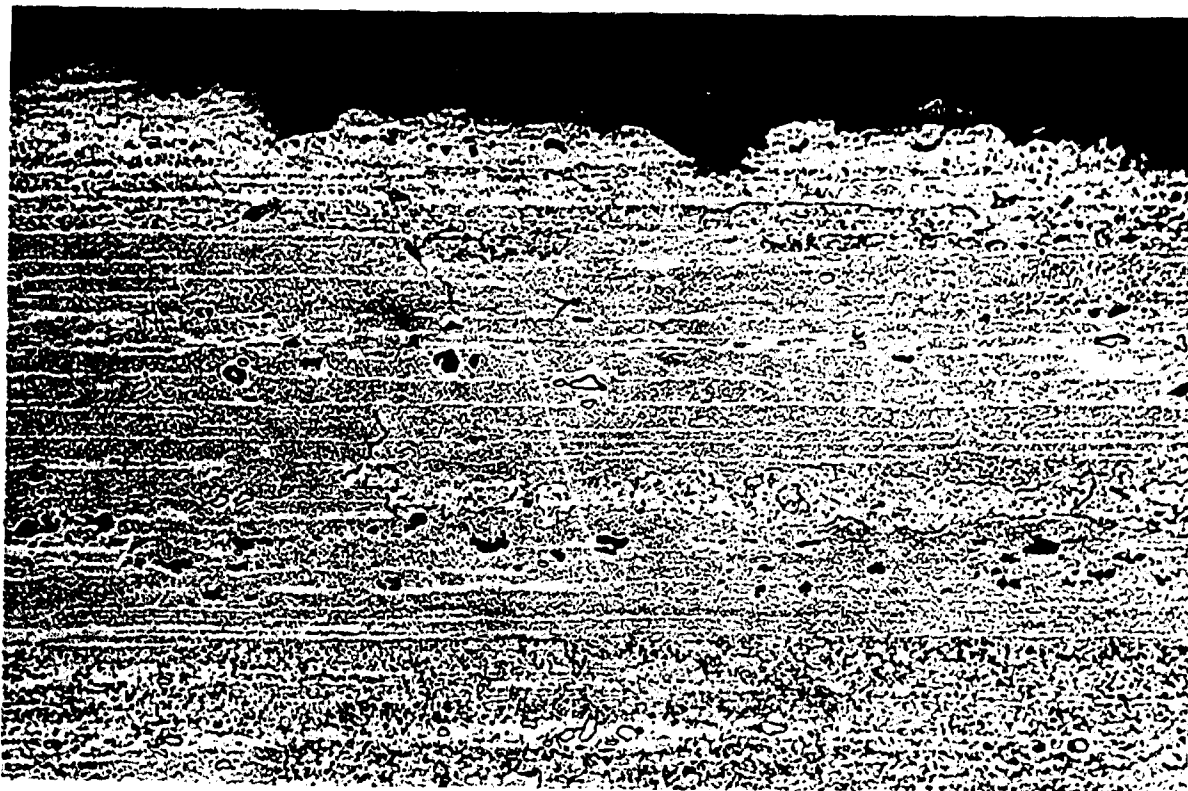


Fig. 21 Center-Notched Fatigue Specimen
(SHARP NOTCH)



*Specimen precracked to 0.50 in.

Fig. 22 Elox Notched Crack Propagation Specimen



2014-T652 SPECIMEN 341016-7

Mag. 100X, Keller's Etch

a. Slow Propagation



2014-T652 SPECIMEN 341016-10

Mag. 100X, Keller's Etch

b. Fast Propagation

STRUCTURE IN THE SURFACE REGION OF FATIGUE CRACK PROPAGATION,
MAX. GROSS STRESS = 12.5 ksi

Fig. 23

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